VOUGHT AERONAUTICS DIVISION

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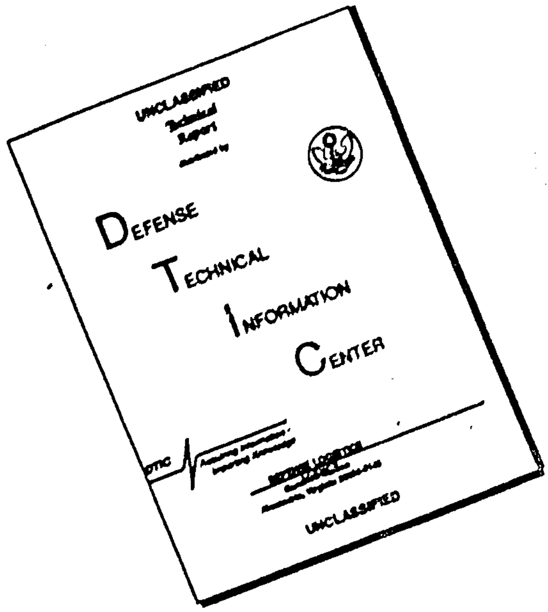

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Report No. 2-55400/8R-6140

April 1968

research on

VTOL WATER HOVER EFFECTS,

including

THE EFFECTS OF WIND AND WAVES

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1.0 INTRODUCTION

The growth and economic advancements made by the nations of the earth have closely paralleled the advances made in transportation and communications systems available to and used by these nations. An advance can be made in the transportation system by improving the flexibility of the system as well as the speed of the system. Just as the automotive vehicles added a large degree of flexibility to the rail system, V/STOL aircraft offers a comparable degree of flexibility to the air transportation systems of the post-1970 time period. By contrast, the ship offers a maximum of flexibility to water transportation systems; but it suffers from a slow speed potential. Some speed advances are being made for the speed potential of ships through the use of hydrofoils, but the potentials offered by these vehicles appear to be less than 100 miles per hour.

The use of seaplanes was examined extensively through the mid-1950's as one potential method of providing a combination flexibility and speed for water transportation systems. The seaplanes did offer the speed, but the seaplane was found to be relatively inflexible with regard to its ability to operate from water surfaces. The seaplane demanded relatively calm water surfaces for takeoff and landing, and such surfaces were not readily found in open ocean areas. Only under emergency conditions were landing attemps made with operational seaplanes under sea conditions more severe than a sea state two.

Recent interest in the ocean and potential advantages it offers to man if he becomes its master has caused a renewed interest in advances that might be made for water transportation systems. Just as the V/STOL

airplane has given a large degree of improvement in the flexibility for the land-based airplane, it may well be capable of providing a comparable degree of increased flexibility to a water transportation system that uses airplanes as the prime carrier. V/STOL aircraft, with slow takeoff and landing speeds, may well be able to permit the operation of air vehicles from open ocean surfaces in all but the most severe weather conditions.

The uses of water-based aircraft which could operate from open ocean surfaces under most weather conditions are many fold. Such vehicles would satisfy the need for many military operations as well as the needs of the civilian community. Some of the military needs that could be satisfied by such a vehicle include the rescue of crews of military aircraft that have gone down at sea, the conduct of anti-submarine warfare operations, and the retrieval of space exploration capsules and/or personnel. The definition of civilian applications are not as readily specified because the lack of a present capability has prevented the establishment of requirements. It is expected that recent interest in oceanographic basic research programs will shortly cause requirements to evolve that can be met by aircraft capable of operating from open ocean surfaces. In addition, VTOL aircraft (helicopters) are being used to transport personnel and equipment to and from offshore oil rigs in coastal areas, and the projected lower operating costs of V/STOL aircraft could make such operations more profitable.

The previous conjectures assume that providing a V/STOL capability to an airplane will permit it to operate from open ocean surfaces under rather severe sea state conditions. Although such an assumption is known to be under investigation, it has not as yet been proven valid.

The ability of V/STOL aircraft to operate from land surfaces has been proven by such test-bed and prototype aircraft as the LTV XC-142A, the Bell X-22A, the Ryan XV-5A, the Canadair CL-84 and the Hawker-Siddley XV-6A. Some very limited tests have been made with some of the aircraft hovering over water surfaces, but there have been no tests which would confirm or reject the possibility that vehicles of this type could operate from open ocean surfaces.

In order to provide a data base suitable for assessing the feasibility of V/STOL aircraft for operating from open ocean surfaces, a limited amount of testing of scale models has been performed (References 1-1, 1-2 and 1-3). Reference 1-1 reports on limited measurements that were made of the spray characteristics around a V/STOL aircraft during hover over a calm and a rough water surface. Reference 1-2 reports on additional qualitative and limited quantitative measurements that were made on a model simulating a V/STOL aircraft hovering over a calm water surface. Under the direction of Reference 1-3, additional quantitative measurements were made using the same model that was used for the tests reported in Reference 1-2. For the tests performed in response to Reference 1-3, measurements were made of the spray characteristics and the forces and moments felt by the model during hover. Again, a calm water surface was used.

As a result of the previous test programs, it was considered desirable to examine the spray characteristics and the forces and moments acting on the model which simulates the airplane hovering over a water surface with water and surface wind conditions varying from calm up to those representative of at least a sea state four condition. Such tests have been conducted in response to Reference 1-4 and the results of these tests are reported herein.

More specifically, the tests reported in this report include the measurement of the water spray passing through potential engine inlet areas behind the propeller at various blade radius stations away from the propeller rotational axis, qualitative evaluations of water spray patterns, and measurement of the forces and moments acting on the model all during simulated hover over a calm water surface with no surface winds, a calm water surface with simulated 40-knot surface winds, a rough water surface (waves with simulated heights of 4.5 and 9 feet) with no surface winds, and a rough water surface with the simulated 40-knot surface wind.

2.0 TEST FACILITIES

2.1 AERO-HYDRO TEST FACILITY

An Aero-Hydro Test Facility was constructed at the LTV Hover Site located adjacent to the LTV Low Speed Wind Tunnel. The facility consists of an open tank, a wave generator, and a wind generator. The existing model support, hydraulic power system for the model, and model instrumentation system were incorporated into the facility with minor modifications but without being relocated. Photographs of the facility are presented in Figures 2-1 and 2-2.

2.1.1 Tank

The tank is a welded structure, 20 feet wide, 75 feet long, and 8 feet high, constructed of 1/4-inch steel plate with external framing. A framework filled with rock and rubberized horsehair and covered with wire mesh is located at the downstream end of the tank to provide damping and to prevent the formation of reflected waves. A sketch of the tank and wave generator is shown in Figure 2-3.

2.1.2 Wave Generator

The wave generator is of the paddle type (i.e., a panel hinged at the bottom of the tank) and located at the upstream end of the tank. It is constructed of aluminum and extends the width of the tank. Rubber strips along the sides and across the bottom seal the edges of the paddle against the sides and bottom of the tank. A 60-gpm sump type water pump is used to pump any water leaking past the seals back into the main part of the tank forward of the paddle. An air spring consisting of an air cylinder and accumulator is used to counterbalance the paddle against the static force of the water against the paddle.

An electro-hydraulic servo-controlled system, programmed to generate a sinusoidal motion, is used to drive the paddle. With the system, it is possible to obtain any combination of amplitude and frequency up to 12 degrees of paddle motion at angular acceleration rates of 0.9 radians per second per second or less. Figure 2-4 is a plot of wave height and length versus paddle amplitude and frequency as calibrated with 7.5 feet of water in the tank.

For the subject test program, 6-inch and 12-inch wave heights were used. For reference to full-scale tests of the XC-142A airplane, these wave heights would represent wave heights of 4.5 and 9.0 feet, respectively.

2.1.3 Wind Generator

The wind generator consists of two Size 9, Class 1 Buffalo-Forge squirrel-cage blowers, each driven at 587 rpm by 50-horsepower electric motors. The blowers are ducted into a common plenum/diffuser having an exit opening 11 feet high by 14 feet wide. The blower exhausts its air due north. The entire assembly is mounted over the water tank on a frame which can be moved along the tank to position the exit face of the diffuser between 10 and 20 feet from the model support. Wind velocities ranging from 10 to 15 knots are obtained over an area 10 feet high by 10 feet wide at 20 feet from the diffuser exit. Photographs of the assembly are presented in Figures 2-5 through 2-8. A plot of air velocities obtained during calibration of the blowers is shown in Figure 2-9.

2.2 MODEL AND MODEL SUPPORT SYSTEM

The test vehicle used for this program was an 0.11-scale hydraulic powered low speed wind tunnel model of the XC-142A V/STOL aircraft. The

model has a wing span of approximately 7-1/2 feet and a body length of 5-1/2 feet.

The external fuselage skins were constructed from fiberglass and attached to a steel fuselage beam which housed a steel balance adapter to accept an internal six-component strain gage balance. The aft end of the strain gage balance was attached to a steel support which extended throughout the upper-aft fuselage skin. The steel support was constructed such that various pitch, yaw, and roll angles could be obtained. The support was suspended from a manually operated hoist to obtain various heights above the water tank.

The control surfaces of this model consist of a vertical tail constructed from steel and fiberglass, a horizontal tail fabricated from aluminum, and a steel wing. The trailing edge of the wing was provided with double-slotted flaps and ailerons. Four fiberglass nacelles were located on the leading edge of the wing which housed four 28-horsepower hydraulic motors. A scaled fiberglass propeller was attached to each of the four motor shafts capable of being rotated at velocities up to 11,000 RPM. The wing was attached to the fuselage beam such that wing incidence angles between 0 and 100 degrees could be obtained.

Additional accessories were fabricated for the model to measure moisture during the water hover test. Two solenoid-operated moisture meters of steel and aluminum construction were mounted on the underside of each wing behind the props during hover operations. An isokinetic probe, with cover attached to moisture meter cover, was fabricated from bent steel tubing containing a moisture filter housing of steel with an aluminum tube leading to a vacuum pump. A hand-operated drop snatcher was made from aluminum, steel, wood, and a glass slide for catching moisture samples. This unit is composed

of a shoulder stock and handgrip and is about 7 feet long. The moisture meters can be seen in Figure 4-1, the isokinetic probe in Figure 4-2, and the droplet snatcher in Figure 4-4.

2.3 TEST INSTRUMENTATION

2.3.1 Model Instrumentation

2.3.1.1 Internal Balance

The 0.11-scale XC-142 model loads were measured by the LTV VTB-2 internal strain gage balance.

The VTB-2 is a six-component strain gage balance configured with a circular hollow along its longitudinal centerline. This hollow serves as a passage for supply and return hydraulic lines which power the four propellers. Corrections to the data were made for fluid tare effects, thermal expansion, and material modulus changes with temperature.

The model attitude (and configuration) remained fixed during a given run; therefore, no correction was necessary for model weight versus model attitude.

A complete bench balance calibration was performed prior to this test. The calibration was accomplished with deadweight loadings using Bureau of Standards class 3 certified weights. Balance output versus load was recorded to an accuracy of one microvolt. The overall balance accuracy (including nonlinearity, hysteresis, and scatter) was approximately 0.20% of full scale.

2.3.1.2 Propeller Thrust Measurement

Each of the four propellers was powered by a Vickers hydraulic motor capable of approximately 28 shaft horsepower per motor. The motor rpm could be varied from 0-11,000 and controlled within ± 2 rpm under ideal conditions and ± 6 rpm under test conditions. A five-component strain gage

thrust cowl was used to measure propeller thrust. The full-scale design thrust of each unit was 50 pounds.

The thrust units were deadweight calibrated with Bureau of Standards class 3 weights. The deadweight calibration outputs were recorded to an accuracy of one microvolt. The overall thrust accuracies (including non-linearity, hysteresis, and scatter) were approximately 0.1% full scale.

2.3.1.3 Moisture Samples

Moisture samples were obtained with two remotely controlled, solenoid-operated meters mounted on each wing between the inboard and outboard propellers and at engine inlet elevation. Each moisture meter contained four traps. A protective cover was rigged and electrically driven to close the traps. The traps remained uncovered for a specific period of time after test conditions were stabilized. The water collected in each trap was weighed with a microbalance to an accuracy of $\pm$1.0 milligram.

2.3.1.4 Data Recording System

The digital recording system was common for strain gage balance and component outputs, thrust outputs, and hydraulic supply pressure and return temperature. The digitizer control unit was connected to an electronic scanner, which in turn transmitted the raw data to an IBM card punch and typewriter. This system records data to an accuracy of approximately .1% of full scale. The propeller rpm was recorded by the use of magnetic pickups, and this pulse signal was displayed on an EPUT meter (frequency counter). A servo control was used to maintain plus or minus 6 rpm. The set point rpm was introduced as fixed data to the card punch and typewriter.

2.3.2 <u>Test Facility Instrumentation</u>

2.3.2.1 Photographic Data

Wave property instrumentation consisted primarily of photographic data.

Visual depth gages were used to measure wave height, period, and model downwash-induced local disturbances which defined the water contour beneath the model. Undisturbed wave shape and properties were monitored upstream of the model. Electrical output depth gages were also used during the test.

Movie cameras were placed around the model to record the visual depth gage data and spray patterns. One camera was mounted above the model to record the general spray patterns. Two additional cameras were positioned at an elevation which caused the camera to use a downward angle of approximately 15° with respect to the water surface and located approximately 80° and 30° to the left of the model heading.

During selected runs, two high speed movie cameras were used to record droplet trajectories, while a high speed still camera was used to photograph droplets in the spray area passing through the propellers.

For runs where the model was at a rolled attitude, two additional cameras were positioned approximately 30° and 90° to the right of the model heading.

2.3.2.2 Electrical Depth Gages

The electrical depth gages acted as potentiometers indexing water level as a function of resistance change. These gages had instantaneous response and a resolution of wave height to within 0.1 inch. The output of these gages was recorded with a light beam oscillograph.

2.3.2.3 Wind Generator

The wind generator was calibrated with an anemometer, which was positioned 20 feet from the wind generator at the model location. The average velocity at this location was 13 knots over an area 8 feet wide by 7 feet high.

2.3.2.4 Ambient Data

An anemometer, thermometer, and barometer were located at the hover facility to measure ambient conditions. These data are presented in the Run Index, Table 2-1.

2.3.3 <u>Data Recording</u>

The recorded data during this test was obtained in the following manner:

a. A wind-off-zero was recorded with the digital data system.
b. Hydraulic pressure was set at the desired level.
c. The wind generator was started.
d. Waves were set to the desired pattern.
e. Propeller rpm was adjusted until the desired thrust level was obtained.
f. When all of the above conditions were obtained and stabilized, the following data were recorded:
    1. Digital data
    2. Moisture samples
    3. Photographic data
    4. Wave pattern data
    5. Ambient conditions
g. The point was terminated, and a final wind-off-zero was recorded with the digital data system.

2.3.4 <u>Data Reduction</u>

2.3.4.1 Six-Component Force and Moment Data

Data from the VTB-2 six-component internal balance were displayed on the digital data system and recorded with an IBM typewriter and card-punch

machine. Using the appropriate constarts, the data were reduced to balance axes data in units of pounds and inch-pounds, converted to coefficient data and transferred to the model center of gravity.

2.3.4.2 Thrust Data

The thrust data were displayed on the digital data system and recorded with an IBM typewriter and card-punch machine. Using the appropriate constant, the data were reduced to pounds of thrust.

2.3.4.3 Data Reduction Factor

S = 931.0896 sq in. (model wing area)

$\bar{c}$ = 10.6548 in. (mean geometric chord)

b = 89.10 in. (model wing span)

Ap = 2.283 sq in. (propeller disc area)

C.G. Location:	F.S.	29.132	
	W.L.	13.200	20% MGC
	B.L.	0.000	

Date Reduction Axes: Wind Axes

2.3.4.4 Data Corrections

All force and moment coefficients were corrected for balance interaction, pressure effects of the hydraulic lines, and for temperature effects. Thrust data were corrected for pressure and temperature effects.

2.3.4.5 Tabulated Data

All tabulated balance and thrust data are presented in Table 2-2. The nomenclature and symbols used in the Run Index and Tabulated Data are as follows:

Aerodynamic Symbol	Definition
AF	Axial force, lb
ALPHA	Model angle of attack, deg
AVET	Average thrust, lb
C_D	Drag coefficient
C_L	Lift coefficient
C_M	Pitching moment coefficient
CRM	Rolling moment coefficient
CTS_{1-4}	Thrust coefficient (subscript denotes position)
CTST	Average thrust coefficient
C_Y	Side force coefficient
CYM	Yawing moment coefficient
D_P	Propeller diameter, inches
H/DP	Ratio of model height to propeller diameter. H is the average distance between the water surface and the two outboard propeller planes at shaft centerline
IW	Wing incidence angle, deg
J_{1-4}	Propeller advance ratio (subscript denotes position)
NF	Normal force, lb
PM	Pitching moment, in-lb
PSI	Model angle of yaw, deg
Pt	Data point number
QS	Slipstream dynamic pressure

Aerodynamic Symbol	Definition
RM	… lling moment, in-lb
RPM_{1-4}	Propeller speed, revolutions per minute (subscript denotes position)
SF	Side force, lb
T_{1-4}	Thrust, lb (subscript denotes position)
T/A	Ratio of thrust to propeller disc area
YM	Yawing moment, in-lb

TABLE NO.
WATER HOVE
RUN II

RUN NO.	RUN PT.	H/D_p	T/A	WAVE HEIGHT (IN.)	WAVE LENGTH (FT.)	BLOWER (ON/OFF)	q (PSF)	ϕ (DEG)	i_w (DEG)	D_p (IN.)	FLOATS (ON/OFF)	MOISTURE SAMPLE (SEC)	TANK SIDE-WALL H (IN)
1	1	3.7	6.45	0	0	OFF	0	0	90	20.46	OFF	0	0
	2		10.32									60	
	3		15.25									60	
2	1	2.5	6.45									0	
	2		10.32									60	
	3		15.25									60	
3	1	1.6	6.45									0	
	2		10.32									60	
	3		15.25									60	
4	1	1.4	6.45									60	
	2		10.32									60	
	3		15.25									60	
5	1	3.7	6.45									0	6.0
	2		10.32									60	
	3		16.25									60	
6	1		6.45			ON	.59					0	
	2		10.32									60	
	3		15.25									60	
7	1		6.45	6.0	5.0	OFF	0					0	
	2		10.32									60	
	3		15.25									60	
8	1		6.45		7.5							0	
	2		10.32									60	
	3		15.25									60	
9	1		6.45		5.0	ON	.59					0	
	2		10.32									60	
	3		15.25									60	

A

TABLE NO. 2-1
ATER HOVER TEST
RUN INDEX

TANK SIDE-WALL HT (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN Hg)	AMBIENT WINDS (DIR / VEL)	REMARKS	DATE 1967
0	78	29.93	0		12/19
↓	↓	↓	↓		↓
	72				
	↓				
	70				
	↓				
	68				
↓	↓		↓		↓
6.0	74		S/10-20		12/20
	↓	↓	↓		↓
	54	29.95	NW/5		12/21
	↓	↓	↓		
	42	30.55	N/4-10		
					↓
					12/22
↓	↓	↓	↓		↓

B

RUN NO.	RUN PT.	H/D_p	T/A	WAVE HEIGHT (IN.)	WAVE LENGTH (F.T.)	BLOWER (ON/OFF)	q (PSF)	ϕ (DEG)	ψ_w (DEG)	D_p (IN)	FLOATS (ON/OFF)	MOISTURE SAMPLE (SEC)	TANK SIDE-WALL HT (IN)
10	1	3.7	6.45	12.0	15	OFF	0	0	90	20.46	OFF	0	6.0
	2		10.32									60	
	3		15.25									60	
11	1		6.45	6.0	7.5	ON	.59	0				0	
	2		10.32									60	
12	1		6.45	0	0	ON	.59		85			0	7.0
	2		10.32									0	
	3		15.25									60	
13	1		6.45						80			0	
	2		10.32									0	
	3		15.25									60	
14	1		6.45						75			0	
	2		10.32									0	
	3		15.25									60	
15	1		6.45						70			0	
	2		10.32									0	
	3		15.25									60	
16	-		15.25						70/0			0	
17	1		6.45	12.0	15	OFF	0		90			0	
18	1	2.5	6.45	0	0	OFF	0		90	20.46	OFF	0	7.0
	2		10.33									60	
	3		15.25									60	
19	1		6.45			ON	.59					0	
	2		10.32									60	
	3		15.25									60	
20	1	2.0	6.45	0	0	OFF	0					0	
	2		10.32									60	
	3		15.25									30	

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...ER HOVER TEST

RUN INDEX

...RE ...LE)	TANK SIDE-WALL HT (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN Hg)	AMBIENT WIND (DIR/VEL)	REMARKS	DATE 1967
	6.0	44	30.55	NW/6-10		12/22
				N/4-10		
	7.0	39	30.14	CALM		12/28
		39				
		39	30.10			
		42				
		44			No Balance Data Taken- Photos Only	
		42				12/29
	7.0	44	30.22	CALM		
					R.H. moisture tray failed to close completely	
		46	30.17	E/4		
				CALM		
					R.H. moisture tray inoperative this pnt	

B

TABLE NO.
WATER HOVE
RUN IND

RUN NO.	PT.	H/D_p	T/A	WAVE HEIGHT (IN.)	WAVE LENGTH (FT.)	BLOWER (ON/OFF)	q (PSF)	ϕ (DEG)	i_w (DEG)	D_p (IN)	FLOATS (ON/OFF)	MOISTURE SAMPLE (SEC)	TAN SIDE WALL (IN
21	1	2.0	6.45	0	0	ON	.59	0	90	20.46	OFF	30	7.0
	2		10.32										
	3		15.25										
22	1		6.45	6.0	7.5	OFF	0					0	
	2		10.32									30	
	3		15.25										
23	1		6.45			ON	.59					0	
	2		10.32									0	
	3											15	
	4		15.25									15	
24	1	3.7	6.45	0.0	0.0	OFF	0					0	
	2		10.32									60	
	3		15.25									60	
25	1		6.45	8.0	10	ON	.59					0	
	2		10.32									60	
26	1	1.6	6.45	0.0	0.0	OFF	0					60	
	2		10.32									30	
27	1		6.45			ON	.59					60	
	2		10.32									30	
28	1		6.45	6.0	7.5	OFF	0					60	
	2		10.32									60	
29	1		6.45			ON	.59					60	
	2		10.32									30	
30	1	1.4	6.45	0.0	C.0	OFF	0					60	
	2		10.32				0					30	
31	1	1.4	6.45	6.0	7.5	ON	.59					30	
	2		10.32									30	

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ABLE NO. 2-1
TER HOVER TEST
RUN INDEX

URE LE c)	TANK SIDE-WALL HT (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN HG)	AMBIENT WINDS (DIR/VEL)	REMARKS	DATE 1968
	7.0	50	30.05	S/5.0		1/2
			30.00	S /8-12		
				S/ 6-8		
		52				
				SE/4		
				CALM		
		46	30.10	N/5		1/15
		48	30.08	NE/6		
		47	30.09	NE/7		
		46		NE/6-8		
		36	30.25	CALM		1/16
		40				
		43				
		51	30.18			
		51				
		54	30.16			
		49	30.12	S/10	B	1/17

RUN NO.	RUN PT.	H/D_p	T/A	WAVE HEIGHT (IN)	WAVE LENGTH (FT)	BLOWER (ON/OFF)	[illegible] (PSF)	[illegible] (DEG)	[illegible] (DEG)	[illegible] (IN)	LOAD [illegible] (ON/OFF)	MOISTURE SAMPLE (SEC)	[illegible] WALL (IN)
32	1	1.4	6.45	0	0	ON	.59	0	90	20.46	OFF	60	7.0
	2		10.32									30	
33	1		6.45	6.0	7.5	OFF	0					60	
	2		10.32									30	
34	1	2.5	6.45									60	
	2		10.32									60	
	3		10.32									60	
	4		15.25									60	
35	1		6.45			ON	.59					60	
	2		10.32									60	
	3		15.25									60	
36	1		6.45	0	0	OFF	0					60	
37	1					ON	.59					60	
38	1	3.7	6.45	6.0	7.5	OFF	0				ON	60	
	2		10.32									60	
	3		15.25									60	
39	1		6.45			ON	.59					0	
	2		10.32									60	
	3		15.25									60	
40	1		6.45	0	0	OFF	0					0	
	2		10.32									60	
	3		15.25									60	
41	1		6.45	0	0	ON	.59					0	
	2		10.32									60	
	3		15.25									60	
42	1	2.5	6.45			OFF	0					0	
	2		10,32									60	
	3		15.25									60	

A

WATER HOVER TEST

RUN INDEX

(SURF ...) (...)	TANK SIDE WALL HT (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN Hg)	AMBIENT WINDS (DIR/VEL)	REMARKS	DATE 1968
	7.0	55	30.14	CALM		1/16
	↓	↓	↓	↓		↓
		49	30.12	S/12		1/17
		50	↓	S/10		↓
		54	30.10	S/8		
		62	30.06	S/10-18		
		50	29.95	S/1		1/24
		45	29.75	S/4		↓
		62	30.06	S/16		1/17
		45	29.75	S/4		1/25
		47	↓	S/2		↓
		60	30.04	S/12	Repeat of Run 18 Pnt 1	1/17
		61	30.04	S/10		↓
		52	30.02	SW/2		1/22
		↓	30.02	↓		↓
			↓	SW/6		
		54	30.01	↓		
		↓	↓			
		56	29.96	N/2		
		↓	↓	↓		
		57				
		59	29.95	NW/3		
		↓	↓	↓		
		56		NW/2		
	↓	↓	↓	↓		↓

B

TABL[illegible]

WATER [illegible]

RU[illegible]

* H/D_p Measured From Avg. Distance Between CL of O.B. Props

RUN NO.	RUN PT.	* H/D_p	T/A	WAVE HEIGHT (IN.)	WAVE LENGTH (FT.)	BLOWER (ON/OFF)	q (PSF)	ϕ (DEG)	[illegible] (DEG)	[illegible] (IN.)	FLOATS (ON/OFF)	MOISTURE SAMPLE (SEC)	TANK SIDE WALL (IN.)
43	1	2.5	6.45	0	0	ON	.59	0	90	20.46	ON	0	7
	2		10.32									60	
	3		15.25									60	
44	1		6.45	12	15						OFF	60	
	2		10.32									60	
	3		15.25									60	
45	1		6.45			OFF	0					0	
	2		10.32									60	
	3		15.25									60	
46	1		10.32	0	0							60	
47	1											60	
48	1											60	
49	1	2.0	6.45	12	15							60	
	2		10.32									60	
50	1		6.45			ON	.59					60	
	2		10.32									60	
51	1	3.7	6.45	6	7.5			-10				0	
	2		10.82									60	
	3		15.25									60	
52	1		6.45			OFF	0					0	
	2		10.82									60	
	3		15.25									60	
53	1		6.45								ON	0	
	2		10.82									60	
	3		15.25									60	
54	1		6.45	0	0							0	
	2		10.82									60	
	3		15.25									60	

TABLE NO. 2-1

WATER HOVER TEST

RUN INDEX

UR[illegible] [illegible]LE (C)	TAN[illegible] S[illegible] [illegible]	AMBI[illegible] TEMP	[illegible]	AMBI[illegible] [illegible]	REMARKS	DATE 1968
	7	40	30.08	CALM		1/24
		44	30.04	S/2		
		45	30.03			
		60	29.76			1/25
		64	29.75	S/3		
		70	29.72			
		72	29.73			
		72	29.68	S/8	Coated Blades for No. 3 here on	
		70	29.90	S-SE/10	No Moisture Data; R.H. Wing	1/31
				S-SE/18		
				S/15		
		66		W/16	Manually Operated Moist. Meter on R.H. Wing Until Noted Otherwise	2/1
			29.88	N-NW/20-22		
		50	30.34	0		2/2
				W-NW/4		
				N-NW/2		
		51		0		
				N/5		

B

TABLE NO
WATER HOV
RUN IND

RUN NO.	RUN PT.	H/D_p	T/A	WAVE HEIGHT (IN.)	WAVE LENGTH (FT.)	BLOWER (ON/OFF)	q (PSF)	φ (DEG)	θ_w (DEG)	D_p (IN.)	FLOATS (ON/OFF)	MOISTURE SAMPLE	TANK SIDE-WALL L (IN.)
55	1	3.7	6.45	6	7.5	OFF	0	-10	90	20.46	OFF	0	7
	2		10.82									60	
	3		15.25									60	
56	1		6.45	0	0							0	
	2		10.82									60	
	3		15.25									0	
57	1		6.45			ON	.59					0	
	2		10.82									60	
	3		15.25									0	
58	1	2.5	6.45			OFF	0					0	
	2		10.82									60	
	3		15.25									60	
59	1		6.45	6	7.5	OFF	0					0	
	2		10.82									60	
	3		15.25									60	
60	1		6.45	12	15.0							0	
	2		10.82									60	
	3		15.25									60	
61	1		6.45	0	0	ON	.59					0	
	2		10.82									60	
	3		15.25									60	
62	1		6.45	6	7.5							0	
	2		10.82									60	
	3		15.25									60	
63	1		6.45	12	15.0							0	
	2		10.82									60	
	3		15.25									60	

A

ABLE NO. 2-1
ER HOVER TEST
UN INDEX

TANK SIDE-WALL HT (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN Hg)	AMBIENT WINDS (DIR / VEL)	REMARKS	DATE 1968
7	56	30.29	S-SW/6		2/2
	60		W/5		
	62	30.28	W/4		
			0		
			SW/4		
			0		
			NE/5		
			E-NE/3		
			0		
			0		
			0		
	46	30.20	NW/5		2/5
	46		NW/5		
	50		N-NW/8		
	56		NW/8		
			N/10		
	58				
	59				
	56	30.18	VAR/2		
	58	30.16	VAR/2-5		
			NE/10		
			NW/8		
			VAR/2		
	45	30.31	NW/4		2/6

B

TABLE I
WATER H
RUN

RUN NO.	PT.	H/D_p	T/A	WAVE HEIGHT (IN.)	WAVE LENGTH (FT.)	BLOWER (ON/OFF)	q (PSF)	ϕ (DEG)	i_w (DEG)	D_p (IN.)	FLOATS (ON/OFF)	MOISTURE SAMPLE (SEC)	TANK SIDE-WALL H (IN.)
64	1	2.5	6.45	0	0	OFF	0	-5	90	20.46	OFF	60	7.0
	2		10.82									60	
	3		15.25									60	
65	1		6.45	6.00	7.5							0	
	2		10.82									60	
	3		15.25									60	
66	1		6.45	12.00	15.0							0	
	2		10.82									60	
	3		15.25									60	
67	1		6.45	0	0	ON	.59					0	
	2		10.82									60	
	3		15.25									60	
68	1		6.45	6.0	7.5							0	
	2		10.82									60	
	3		15.25									60	
69	1		6.45	12.0	15.0							0	
	2		10.82									60	
	3		15.25									60	
70	1		15.25	0	0	OFF	0					120	
				NO BALANCE DATA HERE ON									
71	1		—	0	0	OFF	0	-5	90	20.46	OFF	0	7.0
	2												
	3												
	4												
	5												
	6												
	7												

B

TABLE NO. 2-1
WATER HOVER TEST
RUN INDEX

TANK SIDE-WALL HT (IN)	AMBIENT TEMP (°F)	BARO PRESS (IN Hg)	AMBIENT WINDS (DIR/VEL)	REMARKS	DATE 1968
7.0	36	30.30	VAR/2		2/8
	40		NE/4		
	43		0		
	49		0		
	52		0		
	52		NE/5		
	50	30.25	VAR/2		
			0		
			0		
	50		NW/7		
			VAR/3-4		
			NE/4		
	50	30.23	0		
			N/4		
			0		
	54	30.21	0		
	No Perceptible Sign of Moisture This Run			Using 150-Kinetic moisture sampler	2/9

				THRUST/cts	APPROX	E-PUT	POLYOX	
7.0	58	30.08	VAR/2-4	90	No.3 N.P.	1220		
				185		1770		
				280		2180		
				375		2420		
				470		2720		
				565		2930		
				660		3220	B	

TABLE NO. 2-2

VAD LOW SPEED WIND TUNNEL TEST NO. 26[illegible]
BALANCE AXES DATA

TUNNEL Q 0.0 — 3/[illegible]4/66

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 78.00 — PHI = 0.0 — RUN NO. 1

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	54.057	1.931	34.798	-0.292	-2.623	47.982
2	0.0	0.0	90.00	53.545	2.673	36.483	0.166	-8.627	36.922
3	0.0	0.0	90.00	92.529	4.906	72.828	-0.910	-17.117	-4[illegible]406
4	0.0	0.0	90.00	136.875	5.725	129.182	-7.622	-30.317	-4.0[illegible]

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4152.0	0.0	14.71	4204.0	0.0	14.36	4674.0	0.0	14.7[illegible]	4166.0	0.0
2	0.0	0.0	90.00	14.24	4152.0	0.0	14.92	4204.0	0.0	14.88	4674.0	0.0	14.32	4166.0	0.0
3	0.0	0.0	90.00	24.49	5472.0	0.0	24.70	5442.0	0.0	25.47	4674.0	0.0	24.1[illegible]	5386.0	0.0
4	0.0	0.0	90.00	34.69	6500.0	0.0	34.79	6444.0	0.0	34.58	6942.0	0.0	34.88	6414.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.607	1.0000	1.0003	1.0073	0.9829	1.0094	6.40
2	0.0	0.0	90.00	14.593	1.0000	0.9761	1.0227	1.0198	0.9815	6.39
3	0.0	0.0	90.00	24.689	1.0000	0.9920	1.0004	1.0315	0.9761	10.81
4	0.0	0.0	90.00	34.736	1.0000	0.9987	1.0015	0.9956	1.0042	15.21

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3068	0.0467	0.0693	-0.0071	-0.0005	0.013[illegible]	6.40
2	0.0	0.0	90.00	1.2956	0.0647	0.0695	0.0040	-0.0025	0.010[illegible]	6.39
3	0.0	0.0	90.00	1.3234	0.0702	0.0833	-0.0130	-0.0024	-0.0065	10.81
4	0.0	0.0	90.00	1.3914	0.0582	0.1112	-0.0775	-0.0015	-0.0005	15.21

TABLE NO. 2-2
VAJ LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 72.00 — PHI = 0.0 — RUN NO. 2

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	57.759	1.278	46.287	0.095	-18.282	23.923
2	0.0	0.0	90.00	95.843	3.708	76.980	0.507	-17.508	-14.562
3	0.0	0.0	90.00	135.081	0.895	77.611	-0.259	-28.409	42.962

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4178.0	0.0	14.87	4202.0	0.0	14.67	4596.0	0.0	14.90	4228.0	0.0
2	0.0	0.0	90.00	24.65	5414.0	0.0	24.65	5470.0	0.0	24.73	5958.0	0.0	24.84	5440.0	0.0
3	0.0	0.0	90.00	34.74	6368.0	0.0	34.68	6392.0	0.0	34.90	7010.0	0.0	35.15	6378.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.765	1.0000	0.9896	1.0072	0.9937	1.0094	6.47
2	0.0	0.0	90.00	24.717	1.0000	0.9973	0.9971	1.0036	1.0049	10.83
3	0.0	0.0	90.00	34.867	1.0000	0.9964	0.9947	1.0009	1.0080	15.27

WIND AXES DATA

SLIPSTREAM 0

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CNP	CYM	QS
1	0.0	0.0	90.00	1.3813	0.0306	0.0976	0.0023	-0.0050	0.0064	6.47
2	0.0	0.0	90.00	1.3692	0.0530	0.0923	0.0073	-0.0030	-0.0023	10.83
3	0.0	0.0	90.00	1.3680	0.0091	0.0719	-0.0026	-0.0032	0.0049	15.27

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 70.00 — PHI = 0.0 — RUN NO. 3

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	59.661	2.398	41.633	-0.139	-27.896	-36.945
2	0.0	0.0	90.00	102.414	2.963	55.340	-1.442	-59.680	-60.053
3	0.0	0.0	90.00	145.048	4.868	83.096	0.062	-30.634	-57.349

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.77	4188.0	0.0	14.66	4204.0	0.0	14.67	4554.0	0.0	14.90	4180.0	0.0
2	0.0	0.0	90.00	24.39	5388.0	0.0	24.86	5460.0	0.0	25.36	5890.0	0.0	24.73	5352.0	0.0
3	0.0	0.0	90.00	34.74	6388.0	0.0	35.05	6474.0	0.0	34.74	6966.0	0.0	34.72	6354.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.752	1.0000	1.0032	0.9939	0.9946	1.0103	6.46
2	0.0	0.0	90.00	24.835	1.0000	0.9820	1.0009	1.0212	0.9959	10.88
3	0.0	0.0	90.00	34.814	1.0000	0.9979	1.0368	0.9979	0.9974	15.25

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4281	0.0574	0.0817	-0.0033	-0.0074	-0.0099	6.46
2	0.0	0.0	90.00	1.4561	0.0421	0.0652	-0.0205	-0.0076	-0.0096	10.88
3	0.0	0.0	90.00	1.4793	0.0494	0.0689	0.0006	-0.0035	-0.0065	15.25

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 68.00 — PHI = 0.0 — RUN NO. 4

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	59.445	1.763	31.929	0.043	-15.252	27.135
2	0.0	0.0	90.00	102.503	1.916	50.786	-1.634	-22.941	15.007
3	0.0	0.0	90.00	147.724	4.411	88.139	-2.521	-47.345	29.583

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.51	4154.0	0.0	14.77	4168.0	0.0	14.78	4590.0	0.0	14.80	4184.0	0.0
2	0.0	0.0	90.00	24.76	5372.0	0.0	24.70	5436.0	0.0	24.94	5904.0	0.0	24.63	5360.0	0.0
3	0.0	0.0	90.00	34.43	6358.0	0.0	34.47	6374.0	0.0	34.74	6966.0	0.0	35.04	6358.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.712	1.0000	0.9860	1.0037	1.0044	1.0058	6.44
2	0.0	0.0	90.00	24.756	1.0000	1.0000	0.9977	1.0075	0.9948	10.84
3	0.0	0.0	90.00	34.670	1.0000	0.9930	0.9943	1.0021	1.0107	15.19

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4268	0.0423	0.0632	0.0010	-0.0041	0.0073	6.44
2	0.0	0.0	90.00	1.4620	0.0273	0.0623	-0.0233	-0.0031	0.0024	10.84
3	0.0	0.0	90.00	1.5045	0.0449	0.0750	-0.0257	-0.0048	0.0034	15.19

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 74.00 — PHI = 0.0 — RUN NO. 5

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	55.842	-0.484	21.472	1.093	48.366	19.695
2	0.0	0.0	90.00	95.202	-0.007	58.382	1.550	27.231	74.312
3	0.0	0.0	90.00	136.125	3.023	111.010	0.353	-16.003	99.112

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	15.03	4292.0	0.0	14.66	4242.0	0.0	14.78	4798.0	0.0	14.01	4222.0	0.0
2	0.0	0.0	90.00	24.60	5470.0	0.0	24.54	5490.0	0.0	24.63	6138.0	0.0	24.42	5484.0	0.0
3	0.0	0.0	90.00	34.48	6560.0	0.0	35.03	6520.0	0.0	34.74	7512.0	0.0	34.78	6490.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.619	1.0000	1.0283	1.0029	1.0108	0.9580	6.40
2	0.0	0.0	90.00	24.546	1.0000	1.0021	0.9996	1.0033	0.9947	10.75
3	0.0	0.0	90.00	34.749	1.0000	0.9923	1.0072	0.9998	1.0008	15.22

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3488	-0.0117	0.0511	0.0264	0.0125	0.0053	6.40
2	0.0	0.0	90.00	1.3695	-0.0001	0.0785	0.0223	0.0038	0.0120	10.75
3	0.0	0.0	90.00	1.3833	0.0305	0.0996	0.0036	-0.0019	0.0113	15.22

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q   0.59 — 03/04/68

PRESS TARE   1 — ALPHA TABLE   11

STATIC TARE   0 — TEMP TARE   1

TUNNEL TEMP   74.00 — PHI =   0.0 — RUN NO.   6

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	62.290	21.223	226.354	-1.055	-9.914	19.135
2	0.0	0.0	90.00	100.809	31.481	345.241	-0.752	6.777	14.020
3	0.0	0.0	90.00	141.826	35.113	425.832	-0.276	-53.651	46.062

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.45	4288.0	0.1861	14.92	4254.0	0.1876	14.72	4718.0	0.1691	14.00	4278.0	0.1865
2	0.0	0.0	90.00	24.81	5562.0	0.1435	24.91	5554.0	0.1437	24.79	6178.0	0.1292	24.89	5496.0	0.1452
3	0.0	0.0	90.00	34.64	6568.0	0.1215	34.58	6576.0	0.1214	34.79	7430.0	0.1074	35.25	6554.0	0.1218

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CV	CRM	CYM
1	0.0	0.0	90.00	16.3281	5.5633	4.4201	-0.2767	-0.0223	0.0563
2	0.0	0.0	90.00	26.4254	8.2522	6.7898	-0.1972	0.0248	0.0412
3	0.0	0.0	90.00	37.1770	9.2041	8.5759	-0.0724	-0.1561	0.1335

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.725	0.9162	0.8993	0.9286	0.9161	0.9207	7.04
2	0.0	0.0	90.00	24.849	0.9486	0.9470	0.9509	0.9462	0.9502	11.47
3	0.0	0.0	90.00	34.815	0.9627	0.9578	0.9562	0.9622	0.9748	15.84

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CV	CRM	CYM	QS
1	0.0	0.0	90.00	1.3685	0.4463	0.3705	-0.0232	-0.0019	0.0047	7.04
2	0.0	0.0	90.00	1.3589	0.4244	0.3492	-0.0101	0.0013	0.0021	11.47
3	0.0	0.0	90.00	1.3849	0.3429	0.3195	-0.0027	-0.0058	0.0059	15.84

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 03/04/68

PRESS TARE 1 ALPHA TABLE 11

STATIC TARE 0 TEMP TARE 1

TUNNEL TEMP 54.00 PHI = 0.0 RUN NO. 7

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	57.699	-2.399	7.902	-1.620	-35.834	-3.595
2	0.0	0.0	90.00	94.426	-6.970	-19.041	-2.020	-43.588	-35.946
3	0.0	0.0	90.00	141.188	-7.043	20.244	-3.627	-144.532	-40.624

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4110.0	0.0	14.98	4154.0	0.0	14.88	4626.0	0.0	14.80	4106.0	0.0
2	0.0	0.0	90.00	24.23	5318.0	0.0	24.59	5294.0	0.0	24.21	5858.0	0.0	24.42	5224.0	0.0
3	0.0	0.0	90.00	35.22	6330.0	0.0	34.42	6328.0	0.0	35.32	7536.0	0.0	35.04	6262.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.817	1.0000	0.9861	1.0108	1.0044	0.9987	6.49
2	0.0	0.0	90.00	24.362	1.0000	0.9946	1.0095	0.9937	1.0022	10.67
3	0.0	0.0	90.00	34.998	1.0000	1.0062	0.9835	1.0091	1.0012	15.33

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3751	-0.0572	0.0295	-0.0386	-0.0386	-0.0010	6.49
2	0.0	0.0	90.00	1.3686	-0.1010	-0.0061	-0.0409	-0.0261	-0.0058	10.67
3	0.0	0.0	90.00	1.4245	-0.0711	0.0338	-0.0366	-0.0155	-0.0046	15.33

TABLE NO. 2-2
VAL LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 3/14/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 42.00 — PHI = 0.0 — RUN NO. 9

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	62.152	23.417	211.455	-.522	-37.113	41.445
2	0.0	0.0	90.00	102.[illegible]	23.187	339.946	-1.[illegible]4	-38.742	-13.531
3	0.0	0.0	90.00	145.254	37.295	456.554	-2.123	-54.783	26.297

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.45	4086.0	.1658	14.77	4016.0	0.1901	14.51	4078.0	0.1972	15.06	4140.0	0.1844
2	0.0	0.0	90.00	24.81	5432.0	0.1413	24.54	5266.0	0.145[illegible]	24.63	5363.0	0.1425	25.26	5334.0	0.1431
3	0.0	0.0	90.00	34.85	6344.0	0.12[illegible]4	34.42	6276.0	0.1217	35.37	6703.0	0.1139	34.25	6248.0	0.1222

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.3026	6.1357	3.9354	-0.1308	-0.1458	0.1219
2	0.0	0.0	90.00	26.8109	7.3686	6.3958	-0.4272	-0.1139	-0.0398
3	0.0	0.0	90.00	38.0758	9.7762	9.2629	-0.5598	-0.1474	0.0774

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.695	0.9161	0.9008	0.9232	.9145	0.9387	7.23
2	0.0	0.0	90.00	24.810	0.9465	0.9484	0.9382	0.9415	0.9658	11.46
3	0.0	0.0	90.00	34.721	0.9627	0.9662	0.9543	0.9816	0.9495	15.80

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3686	0.5151	0.33[illegible]4	-0.0115	-0.0[illegible]9	0.01[illegible]2	7.[illegible]3
2	0.0	0.0	90.00	1.3808	0.5915	.3141	-0.[illegible]21	-0.[illegible]54	-0.0021	11.46
3	0.0	0.0	90.00	1.4221	0.3851	.3459	-0.0[illegible]8	-0.0[illegible]55	.0025	15.8[illegible]

TABLE NO. 2-2
VAL LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 03/04/68

PRESS TARE 1 ALPHA TABLE 11

STATIC TARE 0 TEMP TARE 1

TUNNEL TEMP 44.00 PHI = 0.0 RUN NO. 10

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	58.492	-2.422	17.862	-0.051	6.497	-27.337
2	0.0	0.0	90.00	97.439	-2.344	36.891	-2.380	-9.020	-51.049
3	0.0	0.0	90.00	139.113	-9.547	-18.610	-5.372	-191.732	-29.278

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.77	4120.0	0.0	14.92	4116.0	0.0	14.88	4184.0	0.0	14.69	4028.0	0.0
2	0.0	0.0	90.00	25.07	5276.0	0.0	25.22	5256.0	0.0	24.58	5326.0	0.0	24.47	5142.0	0.0
3	0.0	0.0	90.00	34.37	6246.0	0.0	34.21	6170.0	0.0	34.16	6682.0	0.0	35.67	6216.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.817	1.0000	0.9968	1.0072	1.0044	0.9916	6.49
2	0.0	0.0	90.00	24.835	1.0000	1.0095	1.0157	0.9896	0.9853	10.88
3	0.0	0.0	90.00	34.606	1.0000	0.9933	0.9886	0.9873	1.0309	15.16

WING AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3940	-0.0577	0.0519	-0.0012	0.0018	-0.0273	6.49
2	0.0	0.0	90.00	1.3854	-0.0333	0.0561	-0.0338	-0.0006	-0.0081	10.88
3	0.0	0.0	90.00	1.4195	-0.0974	0.0023	-0.0548	-0.0226	-0.0034	15.16

TABLE NO. 2-2

VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/24/68

PRESS TARE 1 — ALPHA TABLE 1[illegible]

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 44.00 — PHI = 0.0 — RUN NO. 11

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	64.370	19.774	23[illegible].452	0.022	-25.994	2[illegible].365
2	0.0	0.0	90.00	105.717	31.803	374.466	[illegible]	-49.487	4[illegible].412

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4100.0	0.1866	14.67	3996.0	0.1915	14.78	4176.0	0.1832	14.75	4128.0	0.1853
2	0.0	0.0	90.00	24.65	5360.0	0.1427	25.01	5262.0	0.1454	24.79	4976.0	0.1477	24.89	5370.0	0.1425

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.8733	5.1833	4.5954	0.0057	-0.0766	0.0599
2	0.0	0.0	90.00	27.7119	8.3383	7.4910	0.0027	-0.1427	0.1189

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.751	0.9163	0.9076	0.9238	0.9179	0.9159	7.95
2	0.0	0.0	90.00	24.835	0.9486	0.9415	0.9554	0.9466	0.95[illegible]7	11.47

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4119	0.4337	0.3849	0.0005	-0.0064	0.0050	7.95
2	0.0	0.0	90.00	1.4258	0.4290	0.3854	0.0001	-0.0073	0.0061	11.47

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.55 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 85.0C — PHI = 0.0 — RUN NO. 12

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	85.00	59.101	18.133	165.468	-108.506	-396.064	-169.027
2	0.0	0.0	85.00	101.228	22.509	274.672	-0.158	3.415	41.723
3	0.0	0.0	85.00	139.959	23.455	304.278	0.285	-63.709	91.871

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	85.00	14.56	4118.0	0.1945	14.71	4028.0	0.1988	14.72	4112.0	0.1948	14.85	4116.0	0.1946
2	0.0	0.0	85.00	24.76	5386.0	0.1487	24.59	5300.0	0.1511	24.58	5336.0	0.1501	24.63	5306.0	0.1510
3	0.0	0.0	85.00	34.74	6350.0	0.1261	34.95	6378.0	0.1256	34.90	6670.0	0.1201	35.15	6270.0	0.1277

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	85.00	15.4922	4.7532	3.0894	-28.4428	-0.4629	-0.4973
2	0.0	0.0	85.00	26.5351	5.9003	5.5393	-0.0414	0.0111	0.1227
3	0.0	0.0	85.00	36.6876	6.1483	6.2164	0.0748	-0.1893	0.2703

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	85.00	14.712	0.9161	0.9066	0.9162	0.9169	0.9248	7.03
2	0.0	0.0	85.00	24.638	0.9482	0.9527	0.9464	0.9458	0.9478	11.38
3	0.0	0.0	85.00	34.933	0.9629	0.9576	0.9632	0.9619	0.9687	15.89

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	85.00	1.2995	0.3987	0.2591	-2.3858	-0.0388	-0.0417	7.03
2	0.0	0.0	85.00	1.3756	0.3059	0.2872	-0.0021	0.0076	0.0064	11.38
3	0.0	0.0	85.00	1.3622	0.2283	0.2368	0.0026	-0.0070	0.0100	15.89

TABLE NO. 2-2
VAL LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 80.00 — PHI = 0.0 — RUN NO. 13

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	80.00	63.962	12.557	154.689	-0.549	-8.43[illegible]	17.679
2	0.0	0.0	80.00	106.291	15.273	238.701	-0.[illegible]99	-27.656	33.5[illegible]
3	0.0	0.0	80.00	143.809	12.157	200.421	0.276	-55.383	37.422

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	80.00	14.56	4112.0	0.1939	14.61	4022.0	0.1982	14.72	4122.0	0.1934	14.75	4114.0	0.1938
2	0.0	0.0	80.00	24.76	5376.0	0.1483	24.70	5314.0	0.1500	24.79	5393.0	0.1477	24.84	5342.0	0.1492
3	0.0	0.0	80.00	34.43	6338.0	0.1258	34.58	6388.0	0.1248	34.43	6638.0	0.1271	34.83	6294.0	0.1267

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	80.00	16.7665	3.2916	3.1752	-0.1440	-0.0212	0.0519
2	0.0	0.0	80.00	27.8621	4.0036	5.0459	-0.0233	-0.0602	0.0986
3	0.0	0.0	80.00	37.6970	3.1867	5.7490	0.0723	-0.1647	0.1101

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	80.00	14.659	0.9158	0.9096	0.9127	0.9199	0.9212	7.01
2	0.0	0.0	80.00	24.770	0.9484	0.9479	0.9457	0.9450	0.9511	11.44
3	0.0	0.0	80.00	34.565	0.9625	0.9586	0.9629	0.9586	0.9698	15.73

WIND AXES DATA

SLIPSTREAM 6

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	80.00	1.4110	0.2775	0.2672	-0.0121	-0.0[illegible]18	0.0[illegible]44	7.[illegible]1
2	0.0	0.0	80.00	1.4371	0.2065	0.2603	-0.0[illegible]12	-0.0[illegible]31	0.0[illegible]51	11.44
3	0.0	0.0	80.00	1.4140	0.1195	0.2156	0.0027	-0.0[illegible]62	0.0[illegible]41	15.73

TABLE NO. 2-2

VAG LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — C3/C4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 75.00 — PHI = 0.0 — RUN NO. 14

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	75.00	64.969	8.500	138.453	-0.745	-18.523	26.970
2	0.0	0.0	75.00	107.851	6.333	189.321	-0.275	-22.960	54.472
3	0.0	0.0	75.00	145.092	1.428	200.199	-0.293	-64.299	40.468

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	75.00	14.61	4114.0	0.1930	14.66	4068.0	0.1952	14.67	4172.0	0.1903	14.69	4160.0	0.1909
2	0.0	0.0	75.00	24.76	5380.0	0.1476	24.65	5322.0	0.1492	24.68	5404.0	0.1469	24.73	5368.0	0.1479
3	0.0	0.0	75.00	34.53	6350.0	0.1251	34.63	6336.0	0.1253	34.79	6604.0	0.1202	35.09	6308.0	0.1259

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	75.00	17.0305	2.2280	2.9462	-0.1953	-0.0497	0.0793
2	0.0	0.0	75.00	28.2713	1.6600	4.3150	-0.0722	-0.0658	0.1603
3	0.0	0.0	75.00	38.0332	0.3743	4.8481	-0.0769	-0.1873	0.1191

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	75.00	14.659	0.9158	0.9129	0.9160	0.9166	0.9179	7.01
2	0.0	0.0	75.00	24.704	0.9483	0.9503	0.9461	0.9474	0.9494	11.41
3	0.0	0.0	75.00	34.762	0.9627	0.9563	0.9590	0.9636	0.9718	15.82

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	75.00	1.4333	0.1875	0.2479	-0.0164	-0.0042	0.0067	7.01
2	0.0	0.0	75.00	1.4619	0.0858	0.2231	-0.0037	-0.0034	0.0083	11.41
3	0.0	0.0	75.00	1.4188	0.0142	0.1809	-0.0029	[illegible]	0.0044	15.82

TABLE NO. 2-2

VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/ 4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 70.00 — PHI = 0.0 — RUN NO. 15

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	70.00	66.955	5.115	121.450	-1.096	-26.[illegible]	22.[illegible]38
2	0.0	0.0	70.00	108.130	-2.526	143.518	-0.126	-29.739	29.[illegible]
3	0.0	0.0	70.00	148.213	-8.369	160.176	0.915	-69.1[illegible]7	56.475

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	70.00	14.72	4180.0	0.1891	14.92	41[illegible]	0.1517	15.67	424[illegible]	0.1864	14.85	41[illegible]	0.1891
2	0.0	0.0	70.00	24.76	540[illegible]	0.1464	24.66	5338.[illegible]	0.1481	24.73	5439.0	0.1453	24.99	53[illegible]	0.1469
3	0.0	0.0	70.00	34.79	6356.0	0.1244	34.58	6314.[illegible]	0.1252	34.85	6556.0	0.12[illegible]	34.78	63[illegible]	0.1254

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	70.00	17.5511	1.3409	2.7111	-0.0252	-0.[illegible]759	0.0648
2	0.0	0.0	70.00	28.3444	-0.6621	3.6661	-0.0332	-0.[illegible]866	0.088[illegible]
3	0.0	0.0	70.00	38.8513	-2.1939	4.3936	0.24[illegible]5	-0.2094	0.1956

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	70.00	14.791	0.9165	0.9119	0.9248	0.9092	0.92[illegible]2	7.[illegible]7
2	0.0	0.0	70.00	24.809	0.9465	0.9465	0.95[illegible]	0.9456	0.9517	11.46
3	0.0	0.0	70.00	34.748	0.9627	0.964[illegible]	0.958[illegible]	0.96[illegible]	0.9634	15.81

WIND AXES DATA

SLIPSTREAM C

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	70.00	1.4650	0.1119	0.2263	-0.0021	-0.[illegible]63	0.[illegible]54	7.[illegible]7
2	0.0	0.0	70.00	1.4598	-0.0341	0.1869	-0.[illegible]17	-0.[illegible]45	0.0045	11.46
3	0.0	0.0	70.00	1.4499	-0.0819	0.164[illegible]	[illegible]	-0.[illegible]76	0.0[illegible]73	15.81

TABLE NO. 2-2
WAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 44.00 — PHI = 0.0 — RUN NO. 18

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	55.188	-1.477	1.479	-0.170	-5.132	18.664
2	0.0	0.0	90.00	53.522	-2.808	8.463	-0.194	12.412	39.146
3	0.0	0.0	90.00	138.579	-0.599	83.139	-0.783	-160.607	-9.776

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4058.0	0.0	14.50	4088.0	0.0	14.72	4198.0	0.0	14.85	4056.0	0.0
2	0.0	0.0	90.00	24.49	5342.0	0.0	24.75	5322.0	0.0	24.58	5438.0	0.0	24.68	5224.0	0.0
3	0.0	0.0	90.00	34.01	6294.0	0.0	33.53	6294.0	0.0	35.06	6870.0	0.0	35.15	6230.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.673	1.0000	0.9958	0.9885	1.0035	1.0121	6.43
2	0.0	0.0	90.00	24.625	1.0000	0.9946	1.0051	0.9980	1.0023	10.79
3	0.0	0.0	90.00	34.434	1.0000	0.9876	0.9737	1.0181	1.0207	15.08

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3281	-0.0356	0.0107	-0.0041	-0.0013	0.0050	6.43
2	0.0	0.0	90.00	1.3410	-0.0403	0.0197	-0.0028	0.0021	0.0063	10.79
3	0.0	0.0	90.00	1.4211	-0.0061	0.0813	-0.0080	-0.0183	-0.0011	15.08

TABLE NO. 2-2
VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/14/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 46.00 — PHI = 0.0 — RUN NO. 19

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	62.931	19.670	207.869	-1.051	-29.4[illegible]	12.085
2	0.0	0.0	90.00	101.020	24.817	306.640	-1.544	-77.513	13.712
3	0.0	0.0	90.00	145.718	22.91[illegible]	340.079	[illegible].387	-95.991	1[illegible]3.141

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.66	4192.0	0.1840	14.77	4022.0	0.1918	14.78	414[illegible].0	0.1863	14.69	4168.0	0.1851
2	0.0	0.0	90.00	24.39	4808.0	0.1604	24.75	5426.0	0.1422	24.63	4342.0	0.1777	25.[illegible]	5428.0	0.1421
3	0.0	0.0	90.00	34.69	641[illegible].0	0.1203	34.89	6492.0	0.1186	35.27	7014.0	0.110[illegible]	35.78	6298.0	0.1225

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.4963	5.1562	4.0494	-0.2755	-0.0757	0.0356
2	0.0	0.0	90.00	26.4805	6.5053	6.2500	-0.1427	-0.2245	0.0403
3	0.0	0.0	90.00	38.1973	6.0067	7.1264	0.1015	-0.2849	0.3034

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.725	0.9162	0.9124	0.9188	0.9164	0.9142	7.64
2	0.0	0.0	90.00	24.691	0.9483	0.9366	0.9526	0.9458	0.9601	11.40
3	0.0	0.0	90.00	35.157	0.9631	0.9503	0.9555	0.9661	0.9802	15.99

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3826	0.4322	0.3394	-0.0231	-0.0067	0.0037	7.64
2	0.0	0.0	90.00	1.3699	0.3365	0.3233	-0.0074	-0.0116	0.0021	11.40
3	0.0	0.0	90.00	1.4096	0.2217	0.2630	0.0037	-0.0105	0.0112	15.99

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/66

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 46.00 — PHI = 0.0 — RUN NO. 2[illegible]

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	58.026	-0.722	25.310	-1.120	-20.511	9.163
2	0.0	0.0	90.00	97.524	-2.003	35.607	-0.754	-24.974	33.492
3	0.0	0.0	90.00	144.570	-1.352	50.080	-2.983	-125.222	-39.643

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.51	4124.0	0.0	14.56	4148.0	0.0	14.93	4230.0	0.0	14.75	4062.0	0.0
2	0.0	0.0	90.00	24.70	5334.0	0.0	24.28	5362.0	0.0	24.94	5494.0	0.0	25.16	5240.0	0.0
3	0.0	0.0	90.60	34.53	6350.0	0.0	35.05	6358.0	0.0	34.43	6866.0	0.0	34.78	6158.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.686	1.0000	0.9878	0.9912	1.0169	1.0041	6.43
2	0.0	0.0	90.00	24.770	1.0000	0.9973	0.9801	1.0070	1.0156	10.85
3	0.0	0.0	90.00	34.696	1.0000	0.9953	1.0102	0.9922	1.0023	15.20

WIND AXES DATA

SLIPSTREAM C

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3952	-0.0174	0.0607	-0.0269	-0.0249	0.0025	6.43
2	0.0	0.0	90.00	1.3902	-0.0286	0.0535	-0.0108	-0.0037	0.0054	10.85
3	0.0	0.0	90.00	1.4713	-0.0138	0.0507	-0.0304	-0.0136	-0.0045	15.20

TABLE NO. 2-2
VAL LOW SPEED WIND TUNNEL TEST NO. 306
BALANCE AXES DATA

TUNNEL Q 0.55 — 03/24/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 50.00 — PHI = 0.0 — RUN NO. 21

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	51.298	17.337	163.664	-0.253	-20.781	-0.757
2	0.0	0.0	90.00	56.774	16.601	215.544	1.253	-1.177	-14.250
3	0.0	0.0	90.00	150.22[illegible]	16.664	283.475	-0.116	-71.410	6.442

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.66	4212.0	0.1842	14.71	4760.0	0.1511	14.62	4144.0	.1873	14.80	4172.0	0.1867
2	0.0	0.0	90.00	24.65	5456.0	0.1422	24.7[illegible]	5570.0	0.1393	24.73	5524.0	0.1415	24.84	5386.0	0.1441
3	0.0	0.0	90.00	34.85	6442.0	0.1205	35.16	6578.0	0.1180	34.53	7148.0	0.1186	34.[illegible]	6290.0	0.1234

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.0682	4.5446	3.0881	-0.0769	-0.0592	-0.0022
2	0.0	0.0	90.00	25.8916	4.3515	4.4344	0.3283	-0.0116	-0.0419
3	0.0	0.0	90.00	35.3782	4.3642	6.0722	-0.0324	-0.0243	0.0248

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.695	0.9160	0.9139	0.9170	0.9111	0.9222	7.03
2	0.0	0.0	90.00	24.730	0.9483	0.9453	0.9471	0.9484	0.9525	11.42
3	0.0	0.0	90.00	34.656	0.9626	0.9679	0.9765	0.9591	0.9468	15.77

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3489	0.3815	0.2592	-0.0065	-0.005[illegible]	-0.00[illegible]2	7.03
2	0.0	0.0	90.00	1.3375	0.2248	0.2275	0.0170	-0.00[illegible]	-0.0022	11.42
3	0.0	0.0	90.00	1.4734	0.1634	0.2272	-0.00[illegible]	-0.0078	0.0009	15.77

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/24/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 90.00 — PHI = 0.0 — RUN NO. 22

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	55.711	-0.320	24.091	-1.336	-20.600	-35.590
2	0.0	0.0	90.00	98.360	2.204	70.939	-2.374	-98.896	-40.604
3	0.0	0.0	90.00	142.406	-1.055	59.824	0.468	-69.052	23.797

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.45	4136.0	0.0	14.66	4214.0	0.0	14.62	4218.0	0.0	14.53	4136.0	0.0
2	0.0	0.0	90.00	23.91	5388.0	0.0	24.33	5424.0	0.0	25.31	5554.0	0.0	25.37	5330.0	0.0
3	0.0	0.0	90.00	34.79	6348.0	0.0	34.42	6408.0	0.0	33.38	6948.0	0.0	34.35	6232.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.567	1.0000	0.9922	1.0065	1.0036	0.9577	6.38
2	0.0	0.0	90.00	24.731	1.0000	0.9670	0.9838	1.0234	1.0258	10.83
3	0.0	0.0	90.00	34.237	1.0000	1.0163	1.0054	0.9749	1.0034	15.00

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CNM	CYM	QS
1	0.0	0.0	90.00	1.3504	-0.0078	0.0564	-0.0324	-0.0048	-0.0098	6.38
2	0.0	0.0	90.00	1.4044	0.0315	0.0886	-0.0339	-0.0150	-0.0065	10.83
3	0.0	0.0	90.00	1.4687	-0.0109	0.0602	0.0048	-0.0081	0.0028	15.00

TABLE NO. 2-2

VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 | 12/14/68
PRESS TARE 1 | ALPHA TABLE 11
STATIC TARE 0 | TEMP TARE 1
TUNNEL TEMP 52.00 ° | PHI = 0.0 | RUN NO. 23

PT	ALPHA	PSI	IW	NF	AF	PM	SF	YM	YM
1	0.0	0.0	90.00	83.114	18.268	307.222	-0.471	-23.986	-5.085
2	0.0	0.0	90.00	105.333	19.870	302.399	0.575	-45.418	-43.683
3	0.0	0.0	90.00	107.452	20.875	314.122	0.373	-70.746	-4.234
4	0.0	0.0	90.00	142.729	16.205	315.695	-0.589	-52.129	53.108

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.56	4198.0	0.1854	14.87	4090.0	0.1903	14.62	4174.0	0.1864	14.64	4194.0	0.1855
2	0.0	0.0	90.00	24.60	5440.0	0.1433	24.86	5530.0	0.1407	24.94	5618.0	0.1386	25.05	5454.0	0.1427
3	0.0	0.0	90.00	24.49	5440.0	0.143	24.59	5472.0	0.1422	24.63	5980.0	0.1301	24.52	5430.0	0.1433
4	0.0	0.0	90.00	33.95	6406.0	0.1215	35.00	6622.0	0.1175	17.61	6798.0	0.1145	35.25	6434.0	0.1209

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.5442	4.7967	4.1094	-0.1234	-0.0675	-0.0151
2	0.0	0.0	90.00	27.6110	5.2367	6.3642	0.1597	-0.1373	-0.1265
3	0.0	0.0	90.00	28.1666	5.4719	6.5983	0.0977	-0.2105	-0.0125
4	0.0	0.0	90.00	37.4136	4.2478	6.6897	-0.1545	-0.1495	0.1474

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.672	0.9159	0.9088	0.9283	0.9126	0.9139	7.02
2	0.0	0.0	90.00	24.862	0.9486	0.9385	0.9484	0.9517	0.9558	11.48
3	0.0	0.0	90.00	24.559	0.9480	0.9454	0.9493	0.9507	0.9466	11.35
4	0.0	0.0	90.00	30.426	0.9576	1.0686	1.1015	0.9541	1.1061	13.92

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3912	0.4027	0.3456	[illegible]	[illegible]	[illegible]	7.02
2	0.0	0.0	90.00	1.4191	0.2677	0.3271	[illegible]	[illegible]	[illegible]	11.48
3	0.0	0.0	90.00	1.4846	0.2645	0.3431	[illegible]	[illegible]	[illegible]	11.35
4	0.0	0.0	90.00	1.5862	0.1851	0.2921	[illegible]	[illegible]	[illegible]	13.92

TABLE NO. 2-2

VAD LOW SPEED WIND TUNNEL TEST NO. 266

BALANCE AXES DATA

03/04/68

TUNNEL Q C.0

PRESS TARE 1

STATIC TARE 0

TUNNEL TEMP 46.C0

PHI = 0.0

ALPHA TABLE 11

TEMP TARE 1

RUN NO. 24

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.C	0.0	90.00	57.559	-2.4C2	6.326	0.439	-6.3C6	25.879
2	0.0	0.0	90.00	97.849	1.616	61.260	1.642	-7.2C3	63.598
3	0.0	0.0	9G.00	142.386	-6.307	-0.190	-1.398	-115.243	-6C.473

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	C.0	0.0	90.C0	14.40	3704.0	0.0	14.45	416C.0	0.0	15.20	4160.0	0.0	14.11	4138.0	0.0
2	C.0	0.0	90.00	24.70	5320.0	0.0	24.75	5360.0	0.0	25.52	5412.0	0.0	24.95	5300.0	0.0
3	G.C	0.0	90.C0	35.16	6340.0	0.0	35.10	630C.0	0.0	42.34	6786.0	0.0	34.72	6262.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.C	0.0	90.C0	14.54C	1.0000	0.9905	0.9939	1.0451	0.9705	6.37
2	C.C	0.0	90.00	24.98C	1.0000	0.9889	0.9909	1.0216	0.9986	10.94
3	C.G	0.0	9G.00	36.832	1.0000	0.9547	0.9531	1.1495	C.9427	16.13

WIND AXES DATA

SLIPSTREAM G

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	G.G	0.0	90.00	1.3979	-0.C583	0.0265	0.0106	-0.0C20	0.0C71	6.37
2	G.0	0.0	90.C0	1.3832	0.0228	0.0766	0.0232	-0.0017	0.01C1	1C.94
3	C.C	0.0	90.00	1.3651	-0.0605	0.0123	-0.C134	-C.0121	-0.0065	16.13

TABLE NO. 2-2
VAC LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 | 03/04/68

PRESS TARE 1 | ALPHA TABLE 11

STATIC TARE 0 | TEMP TARE 1

TUNNEL TEMP 48.00 | PHI = 0.0 | RUN NO. 25

PT	ALPHA	PSI	IW	NF	AF	PP	SF	RM	YM
1	0.0	0.0	90.00	62.958	23.030	235.323	-1.249	-24.133	37.804
2	0.0	0.0	90.00	106.508	30.800	354.536	-1.150	-71.638	15.496

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.56	4190.0	0.1647	14.61	4150.0	0.1886	15.14	4162.0	0.1867	14.75	4224.1	0.1833
2	0.0	0.0	90.00	24.49	5410.0	0.1431	24.75	5392.0	0.1436	25.78	5414.0	0.1434	24.89	5472.0	0.1415

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.5034	5.7669	4.6233	-0.3274	-0.0628	0.1112
2	0.0	0.0	90.00	27.9190	8.0735	7.0554	-0.3014	-0.2733	0.1574

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.764	0.9164	0.9037	0.9068	0.9399	0.9152	7.06
2	0.0	0.0	90.00	24.975	0.9488	0.9304	0.9402	0.9793	0.9455	11.53

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3799	0.4822	0.3866	-0.0274	-0.0053	0.0093	7.06
2	0.0	0.0	90.00	1.4286	0.4131	0.3610	-0.0154	-0.0174	0.0029	11.53

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 23/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 47.00 — PHI = 0.0 — RUN NO. 26

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	59.298	-5.235	-32.269	1.171	33.517	19.685
2	0.0	0.0	90.00	101.314	-5.149	-40.501	5.828	24.604	64.052

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4126.0	0.0	14.66	4168.0	0.0	15.67	4162.0	0.0	14.75	3976.0	0.0
2	0.0	0.0	90.00	24.76	5326.0	0.0	24.86	5370.0	0.0	23.68	5414.0	0.0	24.79	5288.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.521	1.0000	0.9792	0.9826	1.0500	0.9882	6.54
2	0.0	0.0	90.00	24.521	1.0000	1.0096	1.0137	0.9659	1.0108	10.74

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4033	-0.1239	-0.0461	0.0277	0.0382	0.0052	6.54
2	0.0	0.0	90.00	1.4590	-0.0741	-0.0394	0.0839	0.0219	0.0104	10.74

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 | 03/14/68
PRESS TARE 1 | ALPHA TABLE 11
STATIC TARE 0 | TEMP TARE 1
TUNNEL TEMP 46.00 | PHI = 0.0 | RUN NO. 27

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	65.765	16.947	170.573	1.484	-51.500	2.586
2	0.0	0.0	90.00	165.517	4.215	184.777	-0.563	-40.628	-27.629

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.72	4122.0	0.1874	14.71	4150.0	0.1861	15.14	4162.0	0.1856	14.75	4102.0	0.1883
2	0.0	0.0	90.00	24.60	5576.0	0.1365	24.54	5402.0	0.1432	24.68	5414.0	0.1427	25.00	5580.0	0.1384

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	17.2391	4.4424	3.2791	0.3889	-0.1611	0.0076
2	0.0	0.0	90.00	27.6593	2.1535	4.1013	-0.1477	-0.1159	-0.0819

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.830	0.9167	0.9097	0.9096	0.9361	0.9115	7.09
2	0.0	0.0	90.00	24.704	0.9483	0.9442	0.942[illegible]	[illegible].9474	0.9596	11.41

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4355	0.3699	0.2731	0.0324	-0.0134	0.0006	7.09
2	0.0	0.0	90.00	1.4302	0.1114	0.2121	-0.0076	-0.0060	-0.0042	11.41

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 | 03/C4/68

PRESS TARE 1 | ALPHA TABLE 11

STATIC TARE 0 | TEMP TARE 1

TUNNEL TEMP 36.00 | PHI = 0.0 | RUN NO. 28

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	C.0	0.0	90.0C	40.202	-1.081	11.169	-1.498	-20.226	20.628
2	C.0	0.0	90.00	104.442	-1.163	49.425	0.459	-10.089	34.490

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.56	4098.0	0.0	14.71	4130.0	0.0	14.78	4112.0	0.0	14.59	4116.0	0.0
2	C.0	0.0	90.00	24.81	5278.0	0.0	24.75	5320.0	0.0	24.89	5250.0	0.0	24.95	5256.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	C.0	0.0	90.00	14.659	1.0000	0.9932	1.0037	1.0080	0.9951	6.42
2	0.0	0.0	90.00	24.849	1.0000	0.9984	C.9961	1.0017	1.0039	10.98

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.C	0.0	90.00	1.4501	-0.0260	0.0306	-0.0361	-0.0046	0.0056	6.42
2	0.0	0.0	90.00	1.4842	-0.0165	0.0653	0.0065	-0.0018	0.0055	10.88

TABLE NO. 2-2
VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/14/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 40.00 — PHI = 0.0 — RUN NO. 29

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	65.205	16.306	177.681	-0.228	-35.472	5.093
2	0.0	0.0	90.00	106.379	11.267	251.285	-0.449	18.183	-37.221

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4144.0	0.1848	14.87	4068.0	0.1882	14.78	4036.0	0.1897	14.85	4183.0	0.1832
2	0.0	0.0	90.00	24.81	5354.0	0.1430	24.96	5546.0	0.1381	24.63	5452.0	0.1405	25.00	5184.0	0.1477

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	17.2496	4.2742	3.4888	-0.0597	-0.1029	0.0150
2	0.0	0.0	90.00	27.8855	2.9534	5.5724	-0.1176	0.0564	-0.1095

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.778	0.9165	0.9062	0.9223	0.9164	0.9210	7.06
2	0.0	0.0	90.00	24.849	0.9486	0.9470	0.9529	0.9421	0.9543	11.47

WIND AXES DATA

SLIPSTREAM C

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4410	0.3571	0.2915	-0.0050	-0.0086	0.0013	7.06
2	0.0	0.0	90.00	1.4339	0.1519	0.2865	-0.0060	0.0029	-0.0056	11.47

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 03/04/68

PRESS TARE 1 ALPHA TABLE 11

STATIC TARE 0 TEMP TARE 1

TUNNEL TEMP 51.00 PHI = 0.0 RUN NO. 30

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	59.589	-0.819	10.725	0.310	-10.928	22.557
2	0.0	0.0	90.00	104.176	0.118	49.234	-1.368	-35.367	-2.013

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.51	4132.0	0.0	14.35	4192.0	0.0	14.57	4170.0	0.0	14.75	4150.0	0.0
2	0.0	0.0	90.00	24.55	5344.0	0.0	24.70	5398.0	0.0	24.84	5348.0	0.0	24.73	5322.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.541	1.0000	0.9976	0.9866	1.0018	1.0140	6.37
2	0.0	0.0	90.00	24.704	1.0000	0.9936	0.9998	1.0054	1.0012	10.82

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4470	-0.0199	0.0286	0.0075	-0.0032	0.0061	6.37
2	0.0	0.0	90.00	1.4891	0.0017	0.0657	-0.0196	-0.0052	-0.0003	10.82

TABLE NO. 2-2

VAC LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 2.59 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 54.00 — PHI = 0.0 — RUN NO. 31

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	64.356	10.773	138.949	-2.723	-38.841	-4.877
2	0.0	0.0	90.00	107.953	3.421	186.764	-0.639	-48.390	6.492

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.90	4150.0	0.1874	14.92	4182.0	0.1859	14.93	4207.0	0.1851	14.16	4156.0	0.1871
2	0.0	0.0	90.00	24.60	5408.0	0.1438	25.07	5600.0	0.1389	24.68	5488.0	0.1417	24.95	5416.0	0.1436

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.8698	2.8232	2.8355	-0.1896	-0.1056	-0.0143
2	0.0	0.0	90.00	28.2980	0.9125	4.4064	-0.1675	-0.1362	0.0191

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.606	0.9156	0.9027	0.9355	0.9361	0.8878	6.99
2	0.0	0.0	90.00	24.822	0.9485	0.9400	0.9578	0.9431	0.9532	11.46

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4245	0.2384	0.2394	-0.0160	-0.0093	-0.0012	6.99
2	0.0	0.0	90.00	1.4566	0.0479	0.2268	-0.0086	-0.0071	0.0010	11.46

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 55.00 — PHI = 0.0 — RUN NO. 32

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	64.093	12.998	145.541	-0.671	-38.277	11.131
2	0.0	0.0	90.00	109.632	4.043	194.404	-1.527	-59.001	5.018

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.66	4220.0	0.1045	14.98	4154.0	0.1074	[illegible]	4120.0	0.1000	14.59	4264.0	0.1020
2	0.0	0.0	90.00	25.02	5444.0	0.1430	24.59	5570.0	0.1398	24.58	5474.0	0.1422	24.63	5540.0	0.1405

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	17.0104	3.4073	2.0771	-0.1759	-0.1083	0.0327
2	0.0	0.0	90.00	20.7379	1.2170	4.5334	-0.4002	-0.1637	0.0148

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.777	0.9165	0.9094	0.9288	0.9229	0.9046	7.06
2	0.0	0.0	90.00	24.704	0.9483	0.9604	0.9441	0.9434	0.9454	11.41

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4211	0.2047	0.2404	-0.0147	-0.0090	0.0027	7.06
2	0.0	0.0	90.00	1.4060	0.0629	0.2344	-0.0207	-0.0085	0.0008	11.41

TABLE NO. 2-2
VAL LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/?4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 49.00 — PHI = [illegible] — RUN NO. 33

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	61.001	0.496	37.326	-0.176	-39.[illegible]43	-16.13[illegible]
2	0.0	0.0	90.00	103.858	-0.224	49.696	-2.544	-49.073	-7.174

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.[illegible]5	4134.0	0.0	14.92	4206.0	0.0	14.88	4142.0	0.0	14.85	4088.0	0.0
2	0.0	0.0	90.00	24.49	5362.0	0.0	24.65	5424.0	0.0	24.89	5349.0	0.0	24.89	5342.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.778	1.00[illegible]	0.9781	1.0099	1.0[illegible]70	1.0050	6.47
2	0.0	0.0	90.00	24.730	1.003[illegible]	0.9964	0.9966	1.0[illegible]65	1.0066	10.83

WIND AXES DATA

SLIPSTREAM 0

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4596	0.0119	[illegible].813	-0.0042	-0.01[illegible]4	-0.0043	6.47
2	0.0	0.0	90.00	1.4835	-0.0032	[illegible].573	-0.0363	-0.00[illegible]7	-0.0011	10.83

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 54.00 — PHI = 0.0 — RUN NO. 34

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	57.695	-0.364	33.795	-2.268	-28.224	-36.068
2	0.0	0.0	90.00	95.202	5.433	95.505	-0.184	12.077	-11.087
3	0.0	0.0	90.00	95.560	4.788	81.103	-4.629	-107.972	5.831
4	0.0	0.0	90.00	130.535	0.272	57.377	-0.949	-34.303	-40.270

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.77	4172.0	0.0	14.92	4270.0	0.0	14.78	4190.0	0.0	14.69	4180.0	0.0
2	0.0	0.0	90.00	24.65	5232.0	0.0	25.12	5548.0	0.0	23.74	5398.0	0.0	24.58	5400.0	0.0
3	0.0	0.0	00	24.55	5360.0	0.0	24.75	5400.0	0.0	24.73	5480.0	0.0	24.95	5350.0	0.0
4	0.0	0.0	. 00	34.64	6358.0	0.0	34.63	6480.0	0.0	34.69	6296.0	0.0	34.93	6320.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.791	1.0000	0.9986	1.0090	0.9991	0.9933	6.48
2	0.0	0.0	90.00	24.520	1.0000	1.0053	1.0244	0.9681	1.0022	10.74
3	0.0	0.0	90.00	24.744	1.0000	0.9920	1.0003	0.9996	1.0081	10.84
4	0.0	0.0	90.00	34.723	1.0000	0.9975	0.9973	0.9990	1.0061	15.21

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CC	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3774	-0.0087	0.0775	-0.0541	-0.0062	-0.0096	6.48
2	0.0	0.0	90.00	1.3710	0.0782	0.1129	-0.0026	[illegible]	-0.0018	10.74
3	0.0	0.0	90.00	1.3637	0.0683	0.0945	-0.0661	-0.0157	[illegible]	10.84
4	0.0	0.0	90.00	1.3275	0.0028	0.0542	-0.0097	-0.0037	[illegible]	15.21

TABLE NO. 2-2

VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.55   03/ 4/68

PRESS TARE 1   ALPHA TABLE 11

STATIC TARE 0   TEMP TARE 1

TUNNEL TEMP 62.00   PHI = 0.0   RUN NO. 35

PT	ALPHA	PSI	IW	NF	AF	FM	SF	RM	YM
1	0.0	0.0	90.00	66.491	21.065	224.853	-.424	-32.097	18.64
2	0.0	0.0	90.00	133.355	24.111	346.760	-0.183	-37.874	5.574
3	0.0	0.0	90.00	141.368	22.613	416.189	0.883	-41.657	3.279

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.77	4246.0	0.1849	14.82	4164.0	0.1685	14.93	4122.0	0.1934	14.9[illegible]	4274.0	0.1837
2	0.0	0.0	90.00	24.65	5598.0	0.1402	25.01	5534.0	0.1416	24.99	5454.0	0.1439	24.63	5426.0	0.1447
3	0.0	0.0	90.00	34.58	6460.0	0.1215	34.89	6452.0	0.1217	34.22	6582.0	0.1193	34.72	6568.0	0.1199

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	17.4293	5.5271	4.3907	-0.1112	-0.0917	0.0548
2	0.0	0.0	90.00	27.0936	6.3202	7.2261	-0.0461	-0.1102	0.0164
3	0.0	0.0	90.00	37.0571	5.9269	9.0154	0.2315	-0.1283	[illegible]096

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.857	0.9169	0.9115	0.9146	0.9216	0.9198	7.1[illegible]
2	0.0	0.0	90.00	24.822	0.9465	0.9420	0.9559	0.9551	0.9411	11.46
3	0.0	0.0	90.00	34.604	0.9625	0.9620	0.9706	0.9518	0.9658	15.75

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4490	0.4595	0.3650	-0.0092	-0.0076	[illegible]	7.1[illegible]
2	0.0	0.0	90.00	1.3947	0.3253	0.3720	-0.0025	-0.0057	[illegible]	11.46
3	0.0	0.0	90.00	1.3685	0.2221	0.3378	0.0087	-0.0[illegible]	[illegible]	15.75

TABLE NO. 2-2

VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 60.00 — PHI = 0.0 — RUN NO. 36

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	58.774	1.485	63.140	0.322	-8.471	-33.970

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.56	4176.0	0.0	14.56	4260.0	0.0	14.46	4190.0	0.0	14.64	4164.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.554	1.0000	1.0003	1.0001	0.9937	1.0058	6.37

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4259	0.036[illegible]	0.1363	0.0078	-0.0025	-0.0092	6.37

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 61.00 — PHI = 0.0 — RUN NO. 37

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	64.081	21.002	223.985	0.258	-29.636	-0.806

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4230.0	0.1854	14.82	4180.0	0.1877	14.83	4148.0	0.1891	14.85	4268.0	0.1838

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.7976	5.5052	4.3738	0.0675	-0.0889	-0.0124

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.778	0.9165	0.9062	0.9190	0.9197	0.9210	7.06

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4033	0.4599	0.3654	0.0056	-0.0074	-0.0[illegible]2	7.0[illegible]

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 52.00 — PHI = 0.0 — RUN NO. 38

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	52.369	-2.268	-23.433	-2.297	-83.078	-1.609
2	0.0	0.0	90.00	90.513	-2.770	11.066	-3.415	-117.332	-18.102
3	0.0	0.0	90.00	126.556	-1.979	20.616	-5.578	-153.649	-5.409

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.72	4300.0	0.0	14.61	4200.0	0.0	14.62	4120.0	0.0	14.75	4140.0	0.0
2	0.0	0.0	90.00	24.60	5428.0	0.0	24.54	5418.0	0.0	24.68	5260.0	0.0	25.00	5340.0	0.0
3	0.0	0.0	90.00	34.85	6404.0	0.0	34.84	6398.0	0.0	34.53	6224.0	0.0	34.78	6320.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.673	1.0000	1.0030	0.9957	0.9964	1.0049	6.43
2	0.0	0.0	90.00	24.704	1.0000	0.9957	0.9934	0.9990	1.0119	10.82
3	0.0	0.0	90.00	34.749	1.0000	1.0028	1.0026	0.9938	1.0008	15.22

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.2603	-0.0546	-0.0417	-0.0553	-0.0211	-0.0004	6.43
2	0.0	0.0	90.00	1.2937	-0.0396	0.0230	-0.0468	-0.0176	-0.0029	10.82
3	0.0	0.0	90.00	1.2860	-0.0201	0.0238	-0.0567	-0.0161	-0.0006	15.22

TABLE NO. 2-2
VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.55 — 03/[illegible]4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE [illegible]

TUNNEL TEMP 54.00 — PHI = 0.0 — RUN NO. 39

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	57.249	14.898	152.277	-1.757	7.178	0.4[illegible]7
2	0.0	0.0	90.00	126.448	31.126	419.095	-0.461	-53.902	-12.152
3	0.0	0.0	90.00	144.923	31.363	386.040	0.213	-56.445	134.345

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.72	4224.0	0.1845	14.50	4184.0	0.1863	14.36	4116.0	0.1894	14.59	4156.0	0.1876
2	0.0	0.0	90.00	24.86	5470.0	0.1425	24.80	5396.0	0.1445	24.52	5312.0	0.1468	25.05	5470.0	0.1425
3	0.0	0.0	90.00	34.58	6446.0	0.1209	34.47	6478.0	0.1203	34.43	6386.0	0.1221	34.72	6412.0	0.1216

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	15.0049	3.9052	2.9400	-0.46[illegible]6	0.0325	0.0012
2	0.0	0.0	90.00	33.1986	8.1592	8.6260	-0.1210	-0.1556	-0.0358
3	0.0	0.0	90.00	37.9488	8.2212	7.7999	0.0558	-0.1674	0.3952

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.541	0.9152	0.9263	0.9129	0.9037	0.9181	6.96
2	0.0	0.0	90.00	24.810	0.9485	0.9505	0.9483	0.9376	0.9577	11.46
3	0.0	0.0	90.00	34.552	0.9625	0.9634	0.96[illegible]3	0.9590	0.9672	15.72

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.2723	0.3311	0.2493	-0.0351	0.0028	0.0001	6.96
2	0.0	0.0	90.00	1.7097	0.4262	0.4442	-0.0062	-0.0080	-0.0018	11.46
3	0.0	0.0	90.00	1.4255	0.3085	0.2927	0.0021	-0.0063	0.0148	15.72

TABLE NO. 2-2
VAO LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q C.0 — 03/24/68

PRESS TAKE 1 — ALPHA TABLE 11

STATIC TAKE 0 — TEMP TAKE 1

TUNNEL TEMP 56.0C — PHI = 0.0 — RUN NO. 40

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	C.C	0.C	90.00	55.415	-1.074	-4.277	-1.439	-63.083	-24.191
2	C.C	0.0	90.00	92.211	-1.423	10.298	-2.393	-88.864	-12.161
3	0.0	0.0	90.00	128.998	-7.878	-23.502	-3.521	-144.126	-80.561

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	C.0	0.0	90.00	14.72	4194.0	0.0	14.87	4196.0	0.0	14.88	4160.0	0.0	14.85	4172.0	0.C
2	C.0	0.C	90.00	24.91	5438.0	0.0	24.65	5442.0	C.0	24.84	5538.0	0.0	25.16	5374.0	0.0
3	C.0	0.C	90.00	34.74	6400.0	C.0	34.42	6300.0	0.0	34.64	6258.0	0.0	34.88	6380.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	C.C	0.C	9C.00	14.830	1.0000	0.9923	1.0028	1.0035	1.0014	6.50
2	0.C	0.0	90.00	24.888	1.0000	1.0010	0.9903	0.9980	1.0108	10.90
3	C.0	0.0	90.00	34.670	1.0000	1.0021	0.9928	0.9990	1.0061	15.18

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	C.0	0.0	9C.00	1.3194	-0.0446	-0.0003	-0.0343	-0.0160	-0.0065	6.50
2	0.0	0.0	90.00	1.3083	-0.0202	0.0179	-0.0340	-0.0133	-0.0019	10.90
3	C.0	0.0	90.0C	1.3138	-0.0802	-0.0059	-0.0359	-0.0156	-0.0092	15.19

TABLE NO. 2-2

VAD LOW SPEED WIND TUNNEL TEST NO. 266

BALANCE AXES DATA

TUNNEL Q 0.55 03/04/68

PRESS TARE 1 ALPHA TABLE 11

STATIC TARE 0 TEMP TARE [illegible]

TUNNEL TEMP 59.00 PHI = 0.0 RUN NO. 41

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	83.504	23.225	192.450	0.037	-15.175	32.010
2	0.0	0.0	90.00	102.075	32.393	302.696	-0.211	-61.778	38.609
3	0.0	0.0	90.00	133.791	35.445	354.946	-1.922	-26.533	21.215

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.66	4326.0	0.1948	14.87	4150.0	0.1886	14.72	4112.0	0.1917	14.75	4246.0	0.1847
2	0.0	0.0	90.00	24.61	5488.0	0.1429	24.54	5398.0	0.1453	24.84	5376.0	0.1459	24.95	5494.0	0.1427
3	0.0	0.0	90.00	34.74	6440.0	0.1218	34.58	6480.0	0.121[illegible]	34.9[illegible]	6390.0	0.1227	35.[illegible]4	6466.0	0.1213

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.6464	6.0861	3.4776	0.0[illegible]98	-0.[illegible]449	0.1942
2	0.0	0.0	90.00	26.7570	8.4926	5.6935	-0.[illegible]551	-0.18[illegible]4	0.1136
3	0.0	0.0	90.00	35.6739	9.2915	6.8140	-0.5038	-0.0655	0.0624

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	GS
1	0.0	0.0	90.00	14.751	0.9163	0.9109	0.9238	0.9146	0.9159	7.05
2	0.0	0.0	90.00	24.73[illegible]	0.9483	0.9433	0.9411	0.9525	0.9566	11.42
3	0.0	0.0	90.00	34.814	0.9627	0.9607	0.9562	0.9651	0.9693	15.84

WIND AXES DATA

SLIPSTREAM C

PT	ALPHA	PSI	IW	CL	CC	CP	CY	CRM	CYM	GS
1	0.0	0.0	90.00	1.3929	0.5694	0.2910	[illegible]	[illegible]	[illegible]	7.[illegible]
2	0.0	0.0	90.00	1.3822	0.4307	0.2941	-0.0026	[illegible]	[illegible]	11.42
3	0.0	0.0	90.00	1.3064	0.3461	0.2536	-0.0188	[illegible]	[illegible]	15.84

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 26[illegible]
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/[illegible]4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 56.00 — PHI = 0.0 — RUN NO. 42

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	57.116	-4.877	-37.104	-4.237	-63.768	-6.360
2	0.0	0.0	90.00	96.333	-4.414	-33.829	-5.967	-106.768	-37.079
3	0.0	0.0	90.00	131.0[illegible]4	2.377	56.875	-1.952	-147.745	62.165

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	50.00	14.77	4174.0	0.[illegible]	14.82	4228.0	0.[illegible]	14.72	4144.[illegible]	[illegible]	15.[illegible]1	4168.0	0.0
2	0.0	0.0	90.00	24.76	5428.0	0.[illegible]	25.01	5456.0	0.0	24.99	5358.0	[illegible]	25.21	5428.0	0.0
3	0.0	0.0	90.00	34.58	6458.0	0.[illegible]	34.68	6428.0	0.[illegible]	34.69	6266.0	[illegible]	34.67	6350.[illegible]	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	US
1	0.0	0.0	90.00	14.831	1.0000	0.9959	0.9992	0.9928	1.0121	6.5[illegible]
2	0.0	0.0	90.00	24.993	1.0000	0.9905	1.0038	1.0[illegible]1	1.0086	10.95
3	0.0	0.0	50.00	34.643	1.0000	0.9983	1.0011	1.0013	0.9992	15.17

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	US
1	0.0	0.0	90.00	1.3600	-0.1161	-0.0589	-0.1[illegible]	-0.[illegible]191	-[illegible].0[illegible]17	6.5[illegible]
2	0.0	0.0	90.00	1.3616	-0.0624	-0.0320	-0.[illegible]843	-[illegible].148	-[illegible].0[illegible]59	1[illegible].[illegible]
3	0.0	0.0	90.00	1.3360	0.0242	0.[illegible]494	-[illegible]195	-[illegible].164	[illegible].0[illegible]71	15.17

TABLE NO. 2-2
VAC LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q [illegible].59 — [illegible]3/ 4/68

PRESS TARE 1 — ALPHA TABLE 1[illegible]

STATIC TARE [illegible] — TEMP TARE [illegible]

TUNNEL TEMP 40.00 — PHI = [illegible] — RUN NO. 43

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	61.169	20.912	167.880	-1.864	15.455	28.288
2	0.0	0.0	90.00	122.242	26.073	342.302	[illegible].136	-48.188	3.954
3	0.0	0.0	90.00	143.11[illegible]	29.669	411.137	[illegible].797	-65.147	-20.645

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4120.0	0.1864	14.61	4028.0	0.1937	14.88	4012.0	0.1914	14.84	4112.0	0.1868
2	0.0	0.0	90.00	24.76	5348.0	0.1436	24.59	5448.0	0.141[illegible]	24.73	5434.0	0.1413	24.73	5366.0	0.1431
3	0.0	0.0	90.00	34.95	6308.0	0.1217	35.[illegible]	6428.0	0.1195	34.85	633[illegible].0	.1213	34.93	6312.0	0.1217

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.0343	5.4816	2.9984	-0.4887	0.[illegible]575	0.0832
2	0.0	0.0	90.00	26.8009	6.8346	7.0102	0.[illegible]356	-0.1426	0.0116
3	0.0	0.0	90.00	37.5138	7.7771	8.5091	0.2089	-0.2[illegible]86	-0.0607

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.685	0.9161	0.9114	0.9112	0.9282	0.9131	7.[illegible]
2	0.0	0.0	90.00	24.704	0.9483	0.9503	0.9446	0.9494	0.9494	11.41
3	0.0	0.0	90.00	34.906	0.9628	0.9641	0.9654	0.9612	0.96[illegible]7	15.88

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3472	0.4605	0.2519	-0.0411	[illegible]46	0.0[illegible]70	7.[illegible]
2	0.0	0.0	90.00	1.3858	0.3534	0.3625	0.0016	-0.[illegible]74	[illegible]006	11.41
3	0.0	0.0	90.00	1.3939	0.289[illegible]	0.3162	0.0078	-0.[illegible]78	-0.0[illegible]23	15.98

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/ 4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 44.00 — PHI = 0.0 — RUN NO. 44

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	61.939	19.674	189.768	-1.148	-40.074	2.509
2	0.0	0.0	90.00	101.583	23.898	306.629	-0.362	-26.741	-15.141
3	0.0	0.0	90.00	134.834	37.214	326.937	1.126	-58.018	-50.142

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.56	4140.0	0.1864	14.61	4042.0	0.1909	14.67	4034.0	0.1913	14.80	4160.0	0.1855
2	0.0	0.0	90.00	24.97	5380.0	0.1434	24.59	5442.0	0.1416	24.47	5364.0	0.1438	24.68	5380.0	0.1434
3	0.0	0.0	90.00	34.53	6360.0	0.1213	34.79	6494.0	0.1188	34.85	6418.0	0.1202	35.20	6392.0	0.1207

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.2362	5.1571	3.6044	-0.3009	-0.1115	0.0074
2	0.0	0.0	90.00	26.0281	6.2643	6.2503	-0.0950	-0.0753	-0.0445
3	0.0	0.0	90.00	35.3444	9.7550	6.0292	0.2951	-0.1780	-0.1475

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.660	0.9158	0.9096	0.9127	0.9166	0.9245	7.01
2	0.0	0.0	90.00	24.678	0.9482	0.9593	0.9450	0.9403	0.9484	11.40
3	0.0	0.0	90.00	34.841	0.9623	0.9542	0.9613	0.9629	0.9726	15.85

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3664	0.4340	0.3033	-0.0253	[illegible]	[illegible]	7.01
2	0.0	0.0	90.00	1.3783	0.3242	0.3235	-0.0049	[illegible]	[illegible]	11.40
3	0.0	0.0	90.00	1.3157	0.3631	0.2244	0.0112	[illegible]	-0.0055	15.85

TABLE NO. 2-2
VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 | 03/ 4/68

PRESS TARE 1 | ALPHA TABLE 11

STATIC TARE 0 | TEMP TARE 1

TUNNEL TEMP 63.00 | PHI = 0.0 | RUN NO. 45

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	57.001	-0.467	13.380	-0.390	-16.103	45.717
2	0.0	0.0	90.00	56.937	-0.363	47.899	0.441	-16.567	55.524
3	0.0	0.0	90.00	136.034	1.871	89.173	-0.121	-44.109	59.171

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4244.0	0.0	14.77	4258.0	0.0	14.67	4260.0	0.0	14.69	4240.0	0.0
2	0.0	0.0	90.00	24.76	5404.0	0.0	24.86	5508.0	0.0	24.92	5498.0	0.0	24.73	5526.0	0.0
3	0.0	0.0	90.00	34.74	6408.0	0.0	34.58	6438.0	0.0	34.85	6468.0	0.0	35.09	6486.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.686	1.0000	0.9990	1.0055	0.9991	1.0005	6.43
2	0.0	0.0	90.00	24.717	1.0000	1.0016	1.0056	0.9921	1.0007	10.83
3	0.0	0.0	90.00	34.815	1.0000	0.9979	0.9932	1.0009	1.0080	15.25

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3766	-0.0213	0.3339	-0.0094	-0.0041	0.0123	6.43
2	0.0	0.0	90.00	1.3048	-0.3052	0.0653	0.0063	-0.0020	0.0089	10.83
3	0.0	0.0	90.00	1.3799	0.0190	0.0810	-0.0312	-0.0050	0.0067	15.25

TABLE NO. 2-2

VAC LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q C.C — 03/ 4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 64.00 — PHI = 0.0 — RUN NO. 46

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	94.468	-0.448	37.513	-0.246	5.184	45.018

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	24.76	5410.0	0.0	25.[illegible]7	5474.0	0.0	25.15	5464.0	0.0	25.1[illegible]	5422.[illegible]	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	25.019	1.0000	0.9895	1.0019	1.0053	1.0034	19.96

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3333	-0.0063	0.0510	-0.0035	0.0009	0.0071	1[illegible].96

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 3/../68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 70.00 — PHI = 0.0 — RUN NO. 47

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	95.129	-0.746	46.104	-0.955	-9.572	10.249

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	24.86	5476.0	0.0	24.65	5530.0	0.0	24.63	5460.0	0.0	24.52	5476.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	24.664	1.0030	1.0080	0.9993	0.9985	0.9942	10.80

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3619	-0.0107	0.0642	-0.0137	-0.0012	0.0016	10.80

TABLE NO. 2-2
VAC LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 72.00 — PHI = 0.0 — RUN NO. 48

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	95.781	0.529	53.554	0.059	-33.90	26.466

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	24.55	5420.0	0.0	24.86	5542.0	0.0	24.69	5520.0	0.0	24.84	5482.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	24.730	1.0000	0.9925	1.0051	0.9980	1.0044	10.83

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3676	0.0076	0.0702	0.0026	-0.0055	0.0042	10.83

TABLE NO. 2-2

VAD LOW SPEED WIND TUNNEL TEST NO. 266

BALANCE AXES DATA

TUNNEL Q [illegible] | [illegible]3/ 4/68

PRESS TAKE 1 | ALPHA TABLE 11

STATIC TAKE 0 | TEMP TAKE 1

TUNNEL TEMP 72.00 | PHI = 0.0 | RUN NO. 49

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	59.587	2.489	56.644	0.469	-36.645	-36.487
2	0.0	0.0	90.00	98.977	5.147	103.866	1.646	-32.65[illegible]	-28.342

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.61	4268.0	0.0	14.52	4346.0	0.0	14.99	4342.0	0.0	15.[illegible]1	43[illegible]2.0	0.0
2	0.0	0.0	90.00	24.49	5500.0	0.0	24.75	5570.0	0.0	24.68	5524.0	0.0	24.79	5512.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.883	1.000[illegible]	0.9816	1.0028	1.0076	1.0385	6.52
2	0.0	0.0	90.00	24.678	1.0000	0.9925	1.0030	1.[illegible]1	1.0044	10.81

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4137	0.0589	0.1190	0.0111	-0.0100	-0.0057	6.52
2	0.0	0.0	90.00	1.4162	0.0736	0.1242	0.0235	-0.0058	-0.0046	10.81

TABLE NO. 2-2
VAO LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 72.00 — PHI = 0.0 — RUN NO. 5[illegible]

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	61.300	18.505	219.560	-0.131	-44.462	-1.387
2	0.0	0.0	90.00	100.219	16.878	246.139	1.[illegible]90	-38.987	-35.747

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.56	4282.0	0.1862	14.50	4252.0	0.1876	14.57	4254.0	0.1875	14.48	4340.0	0.1837
2	0.0	0.0	90.00	24.91	5584.0	0.1428	24.59	5666.0	0.1423	24.58	5678.0	0.14[illegible]4	24.89	5628.0	0.1417

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.0688	4.8567	4.4001	-0.[illegible]344	-0.130[illegible]	-0.0041
2	0.0	0.0	90.00	26.2705	4.4241	5.1421	0.2858	-0.1218	-0.1[illegible]52

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.528	0.9151	0.9171	0.9136	0.9176	0.9122	6.95
2	0.0	0.0	90.00	24.744	0.9484	0.9549	0.9426	0.9419	0.9541	11.43

WIND AXES DATA

SLIPSTREAM 0

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3635	0.4116	0.3734	-0.0029	-0.[illegible]11[illegible]	-0.00[illegible]3	6.95
2	0.0	0.0	90.00	1.3564	0.2264	0.2655	0.0148	-0.0[illegible]63	-0.0[illegible]54	11.4[illegible]

TABLE NO. 2-2
VAU LCW SPEED WIND TUNNEL TEST NO. 26C
BALANCE AXES DATA

TUNNEL Q 2.59 [illegible] — 03/[illegible]/68

PRESS TARE 1 — ALPHA TABLE [illegible]

STATIC TARE 0 — TEMP TARE [illegible]

TUNNEL TEMP 70.0C — PHI = -1[illegible].0 — RUN NO. [illegible]

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	6[illegible].[illegible]82	22.9[illegible]3	[illegible]53.746	-11.4[illegible]7	-21.31[illegible]	3.3[illegible]4
2	0.0	0.0	90.00	1[illegible]1.49[illegible]	31.521	175.292	-19.[illegible]14	-48.237	1[illegible].[illegible]96
[illegible]	0.0	0.0	90.00	14[illegible].419	35.231	413.426	-2[illegible].432	-41.435	-7[illegible].61[illegible]

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.72	4242.[illegible]	.1829	14.77	4[illegible]46.[illegible]	[illegible].1[illegible]4[illegible]	14.88	4279.[illegible]	.[illegible]8[illegible]4	14.5[illegible]	4326.[illegible]	0.1833
2	0.0	0.0	90.00	24.44	5488.0	[illegible].1445	24.75	5528.0	[illegible].1435	[illegible]4.58	5558.[illegible]	.1427	24.[illegible]	5588.[illegible]	0.1419
3	0.0	0.0	90.00	34.74	6464.0	[illegible].1227	34.74	66[illegible].	[illegible].12[illegible]	34.43	664[illegible].	.1194	[illegible]4.88	65[illegible].[illegible]	0.12[illegible]7

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CP	CY	CRM	CYM
1	0.0	0.[illegible]	90.00	16.8037	6.[illegible]27[illegible]	4.3894	-0.[illegible]755	-[illegible].[illegible]9	[illegible].1392
2	0.0	0.0	90.00	27.1335	8.2526	7.3216	-[illegible].[illegible]14	-[illegible].[illegible]4[illegible]	.[illegible]9
3	0.0	0.0	90.[illegible]	37.3181	9.235[illegible]	4.420	.3248	-[illegible].[illegible]299	[illegible].[illegible]7

PT	ALPHA	PSI	IW	AVE T	CTS1	CTS1	CTS2	CTS3	CTS4	CS
1	0.0	0.[illegible]	90.00	14.725	[illegible].9162	0.9157	0.9188	[illegible].[illegible]755	.9[illegible]43	7.[illegible]
2	0.0	0.0	90.00	24.595	[illegible].9481	0.942[illegible]	0.954[illegible]	[illegible].947[illegible]	.9492	11.[illegible]
3	0.0	0.[illegible]	90.00	34.696	0.962[illegible]	0.9639	0.9637	[illegible].955[illegible]	.9677	15.7[illegible]

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CP	CY	CRM	CYM	QS
1	0.0	0.[illegible]	90.00	1.[illegible]4	[illegible].5[illegible]52	0.4[illegible]98	-[illegible].[illegible]6[illegible]	-[illegible].[illegible]1	[illegible].[illegible]117	7.[illegible]
2	0.0	0.0	90.00	1.4608	0.4293	0.3801	-0.[illegible]7	-[illegible].[illegible]73	.[illegible]12[illegible]	1[illegible].36
3	0.0	0.[illegible]	90.[illegible]	1.3947	0.3451	0.3147	0.[illegible]121	-[illegible].[illegible]	[illegible].[illegible]	15.7[illegible]

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/ 4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 66.CC — PHI = -10.0 — RUN NO. 52

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	55.917	-6.593	-54.747	-13.364	-76.105	5.896
2	0.0	0.0	90.00	94.257	-13.435	-81.206	-22.69[illegible]	-146.183	24.212
3	0.0	0.0	90.00	132.935	-12.3[illegible]8	-67.466	-15.172	-65.251	-43.833

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.93	4220.0	0.0	14.82	4342.0	0.0	14.72	4232.0	0.0	14.69	4156.0	0.0
2	0.0	0.0	90.00	24.49	5328.0	0.0	24.70	5514.0	0.0	24.84	5502.0	0.0	25.00	5358.0	0.0
3	0.0	0.0	90.00	34.90	6352.0	0.0	34.58	6434.0	0.0	34.58	6374.0	0.0	34.72	6400.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.791	1.0000	1.0092	1.0019	0.9955	0.9933	6.48
2	0.0	0.0	90.00	24.757	1.0000	0.9893	0.9976	1.0033	1.0097	10.84
3	0.0	0.0	90.00	34.696	1.0000	1.0259	0.9956	0.9968	1.0068	15.2[illegible]

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	CS
1	0.0	0.0	90.00	1.3700	-0.1574	-0.0906	-0.0826	-0.[illegible]184	-0.0[illegible]1[illegible]	6.48
2	0.0	0.0	90.00	1.3802	-0.1916	-0.0731	-0.[illegible]854	-0.[illegible]213	[illegible].0016	10.84
3	0.0	0.0	90.00	1.3592	-0.1253	-0.0303	0.0827	-0.0095	-0.0067	15.2[illegible]

TABLE NO. 2-8

VAD LOW SPEED WIND TUNNEL TEST NO. 266

BALANCE AXES DATA

TUNNEL Q 0.0 03/04/68

PRESS TARE 1 ALPHA TABLE 11

STATIC TARE 0 TEMP TARE 1

TUNNEL TEMP 90.00 PHI = -10.00 RUN NO. 53

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RP	YM
1	0.0	0.0	90.00	52.124	-4.423	-37.772	-12.830	-139.440	-22.099
2	0.0	0.0	90.00	88.286	-1.989	4.767	-17.628	-142.440	-27.373
3	0.0	0.0	90.00	126.202	-3.314	1.424	-25.108	-213.976	-57.382

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.98	4090.0	0.0	15.03	4342.0	0.0	14.72	4166.0	0.0	14.64	4130.0	0.0
2	0.0	0.0	90.00	24.55	5230.0	0.0	24.65	5232.0	0.0	24.63	5270.0	0.0	24.89	5292.0	0.0
3	0.0	0.0	90.00	35.00	6204.0	0.0	34.95	6270.0	0.0	34.90	6226.0	0.0	34.72	6306.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.843	1.0000	1.0092	1.0125	0.9920	0.9863	6.50
2	0.0	0.0	90.00	24.678	1.0000	0.9946	0.9987	0.9980	1.0087	10.81
3	0.0	0.0	90.00	34.893	1.0000	1.0032	1.0015	1.0002	0.9951	15.28

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CV	CRM	CYM	QS
1	0.0	0.0	90.00	1.2741	-0.1052	-0.0528	-0.0854	-0.0271	-0.0076	6.50
2	0.0	0.0	90.00	1.2879	-0.0285	0.0186	-0.0292	-0.0222	-0.0042	10.81
3	0.0	0.0	90.00	1.3029	-0.0335	0.0177	-0.0346	-0.0234	-0.0064	15.28

TABLE NO. 2-2

[illegible] LOW SPEED WIND TUNNEL TEST NO. [illegible]

BALANCE [illegible] DATA

TUNNEL [illegible]   [illegible]/66

PRESS TAKE 1   ALPHA TABLE [illegible]

STATIC TAKE   TEMP TAKE 1

TUNNEL TEMP [illegible]   PHI = -10.00   RUN NO. 56

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.0	56.757	-3.333	0.198	-7.480	-106.387	-2.387
2	0.0	0.0	90.0	89.937	-1.216	22.663	-15.95[illegible]	-37.015	61.416
3	0.0	0.0	90.0	126.819	4.103	104.839	-21.75[illegible]	-70.41[illegible]	93.617

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.0	14.87	41[illegible].0	[illegible]	15.[illegible]	4140.[illegible]	[illegible]	14.99	4186.[illegible]	[illegible]	15.12	4254.[illegible]	0.[illegible]
2	0.0	0.0	90.0	24.91	5306.0	[illegible]	24.44	5342.[illegible]	[illegible]	24.90	5292.[illegible]	[illegible]	24.79	5364.[illegible]	0.[illegible]
3	0.0	0.0	90.0	34.37	6[illegible]	[illegible]	34.58	6366.[illegible]	[illegible]	34.43	6264.[illegible]	[illegible]	34.83	6356.[illegible]	0.[illegible]

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.0	15.001	1.0000	0.9915	1.0019	0.9990	1.0076	6.57
2	0.0	0.0	90.0	24.678	1.0000	1.0095	0.9902	0.9959	1.0144	10.81
3	0.0	0.0	90.0	34.552	1.0000	0.9949	1.0006	0.9964	1.0080	15.13

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CP	CY	CRM	CYM	QS
1	0.0	0.0	90.0	1.3463	-0.0785	0.0175	0.0564	-0.1295	-0.0006	6.57
2	0.0	0.0	90.0	1.3070	-0.0174	0.019[illegible]	-0.0015	-0.0059	0.0103	10.81
3	0.0	0.0	90.0	1.0150	0.0413	0.0746	0.0059	-0.0082	0.0127	15.13

TABLE NO. 2-2
VAO LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 56.00 — PHI = -10.00 — RUN NO. 55

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	56.515	1.682	59.775	-2.309	-48.531	17.102
2	0.0	0.0	90.00	93.653	5.051	100.406	-19.750	-57.949	-5.907
3	0.0	0.0	90.00	133.963	4.906	131.049	-24.122	-57.393	61.152

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.72	4194.0	0.0	15.03	4280.0	0.0	14.67	4122.0	0.0	14.69	4172.0	0.0
2	0.0	0.0	90.00	24.76	5388.0	0.0	24.75	5422.0	0.0	24.52	5320.0	0.0	24.73	5368.0	0.0
3	0.0	0.0	90.00	34.53	6280.0	0.0	34.42	6362.0	0.0	35.06	6354.0	0.0	34.94	6388.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.778	1.0000	0.9959	1.0170	0.9929	0.9942	6.47
2	0.0	0.0	90.00	24.691	1.0000	1.0026	1.0024	0.9932	1.0017	10.81
3	0.0	0.0	90.00	34.749	1.0000	0.9938	0.9906	1.0088	1.0069	15.22

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3395	0.0402	0.1171	0.1800	-0.0175	0.0073	6.47
2	0.0	0.0	90.00	1.3680	0.0722	0.1192	-0.0458	-0.0082	0.0019	10.81
3	0.0	0.0	90.00	1.3832	0.0499	0.1027	-0.0052	-0.0064	0.0095	15.22

TABLE NO. 2-2
VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL 0 0.0 — 03/14/68

PRESS TAKE 1 — ALPHA TABLE 11

STATIC TAKE 0 — TEMP TAPE 1

TUNNEL TEMP 62.00 — PHI = -10.00 — RUN NO. 56

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	57.954	-3.797	2.451	-10.443	-34.854	-12.389
2	0.0	0.0	90.00	95.577	3.413	49.738	-15.938	-25.344	18.765
3	0.0	0.0	90.00	132.160	7.479	159.328	-29.129	-112.015	5.568

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.77	4148.0	0.0	14.77	4204.0	0.0	14.83	4178.0	0.0	14.80	4220.0	0.0
2	0.0	0.0	90.00	24.60	5324.0	0.0	24.80	5416.0	0.0	24.79	5364.0	0.0	24.89	5420.0	0.0
3	0.0	0.0	90.00	34.79	6390.0	0.0	34.63	6436.0	0.0	34.58	6286.0	0.0	34.88	6386.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.791	1.0000	0.9986	0.9984	1.0026	1.0005	6.48
2	0.0	0.0	90.00	24.770	1.0000	0.9931	1.0014	1.0006	1.0049	10.85
3	0.0	0.0	90.00	34.723	1.0000	1.0021	0.9973	0.9960	1.0046	15.21

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4058	-0.0967	0.0289	-0.0255	-0.0092	-0.0032	6.48
2	0.0	0.0	90.00	1.3813	0.0059	0.0606	0.0127	-0.0044	0.0043	10.85
3	0.0	0.0	90.00	1.3750	0.0761	0.1331	-0.0585	-0.0113	0.0038	15.21

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 62.00 — PHI = -10.00 — RUN NO. 57

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	62.959	22.398	249.072	-10.727	-35.417	-22.858
2	0.0	0.0	90.00	102.562	33.189	379.642	-18.468	-35.452	3.055
3	0.0	0.0	90.00	136.786	37.129	404.684	1.424	-42.477	14.250

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.72	4204.0	0.1860	15.08	4196.0	0.1864	14.83	4208.0	0.1859	14.59	4322.0	0.1810
2	0.0	0.0	90.00	24.76	5420.0	0.1443	24.44	5370.0	0.1456	24.84	5432.0	0.1440	24.68	5512.0	0.1419
3	0.0	0.0	90.00	34.69	6356.0	0.1230	34.42	6434.0	0.1216	35.00	6430.0	0.1216	34.67	6470.0	0.1209

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.7410	5.0712	4.9201	0.0943	-0.1065	0.0609
2	0.0	0.0	90.00	27.3170	8.7000	7.3890	-0.1025	-0.1018	0.2027
3	0.0	0.0	90.00	35.2473	9.7328	7.7347	6.5893	-0.2877	0.2479

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.804	0.9166	0.9112	0.9338	0.9182	0.9032	7.07
2	0.0	0.0	90.00	24.678	0.9482	0.9512	0.9389	0.9544	0.9484	11.40
3	0.0	0.0	90.00	34.696	0.9626	0.9625	0.9550	0.9712	0.9619	15.79

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3963	0.4897	0.4104	0.0079	-0.0089	0.0051	7.07
2	0.0	0.0	90.00	1.4140	0.4503	0.3825	-0.0053	-0.0053	0.0105	11.40
3	0.0	0.0	90.00	1.3173	0.3638	0.2891	0.2463	-0.0108	0.0093	15.79

TABLE NO. 2-2

VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 13/24/68

PRESS TAKE 1 — ALPHA TABLE 11

STATIC TAKE 0 — TEMP TAKE 1

TUNNEL TEMP 62.00 — PHI = -10.00 — RUN NO. 58

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	57.134	-0.914	25.444	-1.467	-0.725	26.362
2	0.0	0.0	90.00	95.398	-2.947	5.040	-7.603	-30.428	-2.844
3	0.0	0.0	90.00	133.144	0.506	81.135	-20.852	-10.179	39.527

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.82	4118.0	0.0	15.08	4260.0	0.0	14.99	4218.0	0.0	14.48	4228.0	0.0
2	0.0	0.0	90.00	24.49	5328.0	0.0	24.44	5452.0	0.0	24.89	5410.0	0.0	24.84	5444.0	0.0
3	0.0	0.0	90.00	34.85	6274.0	0.0	34.74	6436.0	0.0	34.85	6406.0	0.0	34.99	6340.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.843	1.0000	0.9986	1.0161	1.0097	0.9756	4.50
2	0.0	0.0	90.00	24.665	1.0000	0.9930	0.9907	1.0091	1.0071	10.00
3	0.0	0.0	90.00	34.854	1.0000	0.9998	0.9966	0.9998	1.0038	15.27

WIND AXES DATA

SLIPSTREAM 6

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3447	-0.0217	0.3502	0.2015	-0.0092	0.0081	4.50
2	0.0	0.0	90.00	1.3597	-0.0422	0.3160	0.1290	-0.0081	-0.0003	10.00
3	0.0	0.0	90.00	1.3651	0.0051	0.0684	0.0260	-0.0018	0.0060	15.27

TABLE NO. 2-8

VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 03/04/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 46.00 — PHI = -10.00 — RUN NO. 59

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	56.319	-6.034	-37.641	-11.577	-57.905	-32.380
2	0.0	0.0	90.00	93.443	-2.688	18.923	-16.819	-31.778	7.197
3	0.0	0.0	90.00	131.744	-2.589	58.544	-25.493	-51.558	22.349

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.82	4140.0	0.0	14.71	4176.0	0.0	14.72	4168.0	0.0	14.85	4162.0	0.0
2	0.0	0.0	90.00	24.76	5320.0	0.0	24.86	5400.0	0.0	24.73	5300.0	0.0	24.68	5314.0	0.0
3	0.0	0.0	90.00	34.85	6280.0	0.0	34.84	6392.0	0.0	34.58	6288.0	0.0	34.72	6384.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.778	1.0000	1.0030	0.9957	0.9964	1.0049	6.47
2	0.0	0.0	90.00	24.756	1.0000	1.0000	1.0040	0.9990	0.9970	10.84
3	0.0	0.0	90.00	34.749	1.0000	1.0028	1.0026	0.9953	0.9992	15.22

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3733	-0.1442	-0.0408	-0.0389	-0.0146	-0.0103	6.47
2	0.0	0.0	90.00	1.3542	-0.0383	0.0312	-0.0050	-0.0050	0.0017	10.84
3	0.0	0.0	90.00	1.3634	-0.0263	0.0567	-0.0228	-0.0053	0.0037	15.22

TABLE NO. 2-2
VAU LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL G 0.0 03/04/63

PRESS TARE 1 ALPHA TABLE 11

STATIC TARE 2 TEMP TARE 1

TUNNEL TEMP 56.00 PHI = -10.00 RUN NO. 6[illegible]

PT	ALPHA	PSI	IW	NF	AF	PM	SF	NM	YM
1	0.0	0.0	90.00	57.372	-3.802	-1.313	-12.680	-67.136	8.501
2	0.0	0.0	90.00	98.147	-6.743	-10.246	-14.529	7.471	20.722
3	0.0	0.0	90.00	132.562	-7.776	-18.576	-26.069	-79.495	-94.136

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.51	4140.0	0.0	14.87	4240.0	0.0	14.67	4176.0	0.0	14.43	4246.0	0.0
2	0.0	0.0	90.00	25.07	5308.0	0.0	24.75	5520.0	0.0	24.94	5380.0	0.0	25.00	5434.0	0.0
3	0.0	0.0	90.00	34.79	6316.0	0.0	34.95	6458.0	0.0	34.90	6306.0	0.0	35.04	6386.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.620	1.0000	0.9923	1.0172	1.0036	0.9869	6.40
2	0.0	0.0	90.00	24.941	1.0000	1.0052	0.9924	1.0001	1.0023	10.92
3	0.0	0.0	90.00	34.920	1.0000	0.9964	1.0007	0.9994	1.0034	15.29

WIND AXES DATA

SLIPSTREAM G

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4178	-0.0918	0.0141	-0.0612	-0.0167	0.0017	6.40
2	0.0	0.0	90.00	1.4642	-0.0955	0.0015	0.0305	0.0002	0.0030	10.92
3	0.0	0.0	90.00	1.3659	-0.0786	0.0078	-0.0270	-0.0084	-0.0064	15.29

TABLE NO. 2-9
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/24/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 59.00 — PHI = -10.00 — RUN NO. 61

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	63.558	23.318	251.955	-9.648	-30.935	-27.000
2	0.0	0.0	90.00	100.279	30.065	296.746	-16.689	-21.491	-158.964
3	0.0	0.0	90.00	134.546	31.240	363.018	-24.060	-39.400	-225.003

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.72	4190.0	0.1864	14.98	4152.0	0.1881	14.67	4156.0	0.1879	14.69	4290.0	0.1821
2	0.0	0.0	90.00	24.49	5380.0	0.1452	24.91	5594.0	0.1396	24.63	5692.0	0.1372	24.89	5456.0	0.1432
3	0.0	0.0	90.00	34.90	6380.0	0.1224	34.47	6546.0	0.1193	34.32	6672.0	0.1171	35.09	6484.0	0.1205

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.8467	6.1125	4.9578	0.4001	-0.1029	0.0504
2	0.0	0.0	90.00	26.6466	7.8811	6.2412	0.2528	-0.0695	-0.3091
3	0.0	0.0	90.00	36.3445	8.1889	8.0653	-0.0004	-0.1159	-0.4666

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.764	0.9164	0.9134	0.9296	0.9107	0.9119	7.06
2	0.0	0.0	90.00	24.730	0.9483	0.9392	0.9552	0.9444	0.9546	11.42
3	0.0	0.0	90.00	34.697	0.9626	0.9683	0.9564	0.9522	0.9736	15.79

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4085	0.5111	0.4145	0.0335	-0.0084	0.0042	7.06
2	0.0	0.0	90.00	1.3765	0.4071	0.3224	0.0131	-0.0036	-0.0160	11.42
3	0.0	0.0	90.00	1.3583	0.3060	0.3014	-0.0000	-0.0043	-0.0174	15.79

TABLE NO. 2-2

VAD LOW SPEED WIND TUNNEL TEST NO. 266

BALANCE AXES DATA

TUNNEL Q 0.59 — [illegible]/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE [illegible] — TEMP TARE 1

TUNNEL TEMP 58.00 — PHI = -10.0 — RUN NO. 62

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	63.826	22.583	240.892	-9.927	-23.456	-23.018
2	0.0	0.0	90.00	99.358	28.346	313.748	-14.520	6.366	-51.334
3	0.0	0.0	90.00	135.961	26.781	329.159	-24.276	-21.445	-134.069

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.51	4178.0	0.1868	14.87	4194.0	0.1861	14.93	4356.0	0.1792	14.85	4304.0	0.1814
2	0.0	0.0	90.00	24.60	5380.0	0.1449	24.70	5440.0	0.1435	24.89	5566.0	0.1402	24.52	5494.0	0.1421
3	0.0	0.0	90.00	34.69	6370.0	0.1225	34.64	6560.0	0.1190	34.90	6723.0	0.1162	34.72	6510.0	0.1199

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.9285	5.9198	4.7125	0.3403	-0.0774	0.0963
2	0.0	0.0	90.00	26.3102	7.4364	6.2867	0.7707	-0.[illegible]063	0.2114
3	0.0	0.0	90.00	36.2031	7.0201	7.0980	-0.[illegible]829	-0.[illegible]610	-0.2204

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.791	0.9165	0.8989	0.9215	0.9254	0.9203	7.07
2	0.0	0.0	90.00	24.677	0.9482	0.9452	0.9491	0.9564	0.9423	11.40
3	0.0	0.0	90.00	34.788	0.9627	0.9600	0.9642	0.9658	0.9609	15.83

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4131	0.4541	0.3934	0.[illegible]284	-0.0065	0.0[illegible]47	7.07
2	0.0	0.0	90.00	1.[illegible]619	0.3846	0.3254	0.0399	-0.00[illegible]	0.2006	11.4[illegible]
3	0.0	0.0	90.00	1.3496	0.2617	0.2646	-0.0[illegible]31	-0.0023	-0.0[illegible]82	15.83

TABLE NO. 2-2

VAD LOW SPEED WING TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.55 03/04/68

PRESS TARE 1 ALPHA TABLE 11

STATIC TARE 0 TEMP TARE 1

TUNNEL TEMP 45.00 PHI = -10.00 RUN NO. 63

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	63.756	22.167	244.079	-10.709	-27.489	-7.263
2	0.0	0.0	90.00	98.007	28.025	294.357	-16.776	-33.011	-108.799
3	0.0	0.0	90.00	136.365	27.859	359.897	-28.147	-14.177	-200.605

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.72	4188.0	0.1836	14.87	4196.0	0.1832	14.72	4342.0	0.1771	14.90	4308.0	0.1789
2	0.0	0.0	90.00	24.60	5296.0	0.1452	24.86	5440.0	0.1413	24.58	5470.0	0.1406	24.75	5430.0	0.1416
3	0.0	0.0	90.00	34.75	6320.0	0.1217	35.26	6514.0	0.1160	35.06	6520.0	0.1179	34.56	6424.0	0.1197

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.9461	5.8106	4.7450	0.1354	-0.0842	0.1036
2	0.0	0.0	90.00	26.0641	7.3462	6.0796	0.1269	-0.1002	-0.1650
3	0.0	0.0	90.00	36.4836	7.3028	8.0685	-1.0638	-0.0154	-0.3975

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.804	0.9166	0.9112	0.9208	0.9117	0.9228	7.77
2	0.0	0.0	90.00	24.704	0.9463	0.9442	0.9541	0.9434	0.9515	11.41
3	0.0	0.0	90.00	34.915	0.9629	0.9594	0.9723	0.9666	0.9531	15.08

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4134	0.4846	0.3958	0.0113	-0.0097	0.0096	7.77
2	0.0	0.0	90.00	1.3477	0.3799	0.3144	0.0066	[illegible]52	-0.0085	11.41
3	0.0	0.0	90.00	1.3552	0.2715	0.2547	-0.0395	[illegible]	-0.0146	15.88

TABLE NO. 2-2
VAC LOW SPEED WING TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL Q 0.0 — 12/ 4/68

PRESS TANK 1 — ALPHA TABLE 11

STATIC TANK 0 — TEMP TANK 1

TUNNEL TEMP 36.00 — PHI = -5.0 — RUN NO. 44

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	58.330	-0.753	41.723	1.681	7.663	-3.362
2	0.0	0.0	90.00	58.156	-4.814	23.533	-2.630	38.413	38.100
3	0.0	0.0	90.00	135.839	-1.862	71.656	0.407	-3.275	39.709

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.77	4024.0	0.0	14.92	4236.0	0.0	14.62	4130.0	0.0	14.90	4196.0	0.0
2	0.0	0.0	90.00	24.60	5630.0	0.0	24.91	5488.0	0.0	24.84	5360.0	0.0	24.52	5334.0	0.0
3	0.0	0.0	90.00	34.04	6196.0	0.0	34.47	6436.0	0.0	34.69	6268.0	0.0	34.99	6286.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.804	1.0000	0.9976	1.0081	0.9875	1.0067	6.48
2	0.0	0.0	90.00	24.717	1.0000	0.9952	1.0078	1.0049	0.9921	11.83
3	0.0	0.0	90.00	34.696	1.0000	0.9963	0.9936	0.9956	1.0084	15.2

WING AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3913	-0.0179	0.0971	0.0461	0.0011	-0.0015	6.48
2	0.0	0.0	90.00	1.4023	-0.0688	0.0458	-0.0376	0.0071	0.0061	11.83
3	0.0	0.0	90.00	1.3825	-0.0152	0.0726	0.0082	-0.0076	0.0045	15.2

TABLE NO. 2-2
VAD LOW SPEED WIND TUNNEL TEST NO. 266
BALANCE AXES DATA

TUNNEL G ... 03/ 4/68

PRESS TAPE 1 ALPHA TABLE 1[illegible]

STATIC TAPE 0 TEMP TAPE 1

TUNNEL TEMP 49.00 PHI = -5.00 RUN NO. 65

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	59.231	0.755	58.083	0.994	6.423	7.810
2	0.0	0.0	90.00	56.482	-3.750	12.221	1.291	23.760	20.131
3	0.0	0.0	90.00	135.594	-7.996	2.436	1.772	14.878	43.567

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.82	4076.0	0.0	14.87	4222.0	0.0	14.88	4198.0	0.0	14.74	4227.0	0.0
2	0.0	0.0	90.00	24.81	5268.0	0.0	24.65	5456.0	0.0	24.58	5312.0	0.0	24.63	5364.0	0.0
3	0.0	0.0	90.00	34.64	6260.0	0.0	34.47	6410.0	0.0	34.64	6283.0	0.0	34.78	6387.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	GS
1	0.0	0.0	90.00	14.837	1.0000	0.9954	1.0026	1.0035	0.9543	6.57
2	0.0	0.0	90.00	24.664	1.0001	1.0058	0.9992	0.9964	0.9985	10.87
3	0.0	0.0	90.00	34.630	1.0000	1.0002	0.9954	1.[illegible]2	1.0042	15.17

WIND AXES DATA

SLIPSTREAM G

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	GS
1	0.0	0.0	90.00	1.4163	0.0186	0.1261	0.0237	0.0011	0.0021	6.57
2	0.0	0.0	90.00	1.3813	-0.0537	0.0275	0.0185	0.0014	0.0032	10.80
3	0.0	0.0	90.00	1.3826	-0.0815	0.0192	0.0181	0.0013	0.0056	15.17

TABLE NO. 2-2

VAU LOW SPEED WIND TUNNEL TEST NO. 264

BALANCE AXES DATA

TUNNEL Q 0.0 — 03/ 4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 50.00 — PHI = -5.00 — RUN NO. 66

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	58.794	-6.197	-27.912	0.541	13.510	0.714
2	0.0	0.0	90.00	96.735	-6.702	-18.229	1.578	8.012	32.929
3	0.0	0.0	90.00	134.528	-7.466	4.680	-6.766	-100.807	-4.752
4	0.0	0.0	90.00	-0.867	0.318	-0.803	-0.727	-0.161	-1.308

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.66	4068.0	0.0	14.82	4280.0	0.0	14.93	4134.0	0.0	14.69	5680.0	0.0
2	0.0	0.0	90.00	24.70	5254.0	0.0	24.80	5490.0	0.0	24.64	5324.0	0.0	24.89	5364.0	0.0
3	0.0	0.0	90.00	34.53	6220.0	0.0	34.89	6424.0	0.0	34.85	6280.0	0.0	34.67	6394.0	0.0
4	0.0	0.0	90.00	-0.32	2.0	0.0	-0.42	2.0	0.0	-0.31	2.0	0.0	-0.58	2.0	0.0

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.777	1.0000	0.9923	1.0028	1.0106	0.9542	6.47
2	0.0	0.0	90.00	24.809	1.0000	0.9957	0.9996	1.0011	1.0034	10.87
3	0.0	0.0	90.00	34.735	1.0000	0.9941	1.0045	1.0032	0.9981	15.21
4	0.0	0.0	90.00	-0.408	1.0001	0.7732	1.0398	0.7779	1.4254	-0.18

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4049	-0.1481	-0.0320	0.0129	0.0033	0.0002	6.47
2	0.0	0.0	90.00	1.3760	-0.0954	-0.0047	0.0225	0.0017	0.0143	10.87
3	0.0	0.0	90.00	1.3676	-0.0759	0.0201	-0.0688	-0.0098	-0.0005	15.21
4	0.0	0.0	90.00	0.7564	-0.2757	0.1222	0.6294	-0.0140	0.0127	-0.18

TABLE NO. 2-2
VAC LOW SPEED WIND TUNNEL TEST NO. 2[illegible]
BALANCE AXES DATA

TUNNEL Q 0.59 — 03/[illegible]/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 50.00 — PHI = -5.0[illegible] — RUN NO. [illegible]7

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	63.735	23.255	238.852	-0.490	-23.976	37.761
2	0.0	0.0	90.00	101.416	28.337	328.619	-1.454	-42.953	-51.218
3	0.0	0.0	90.00	138.285	24.431	322.814	0.164	-19.246	-116.536

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.66	4158.0	0.1866	14.62	4200.0	0.1861	14.88	4136.0	0.1872	14.90	4290.0	0.1803
2	0.0	0.0	90.00	24.70	5360.0	0.1443	24.70	5508.0	0.1404	25.05	5514.0	0.1403	24.89	5482.0	0.1411
3	0.0	0.0	90.00	34.79	6322.0	0.1223	34.63	6572.0	0.1177	34.64	646[illegible].0	0.1197	34.93	6454.0	0.1198

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.7070	6.0959	4.6176	-0.1284	-0.[illegible]574	0.1111
2	0.0	0.0	90.00	26.5845	7.4260	6.5510	-0.3812	-0.1171	-0.1567
3	0.0	0.0	90.00	36.2488	6.4043	6.6196	0.0429	-0.[illegible]577	-0.3428

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.817	0.9167	0.9072	0.9168	0.9207	0.9220	7.08
2	0.0	0.0	90.00	24.835	0.9486	0.9435	0.9433	0.9566	0.9507	11.47
3	0.0	0.0	90.00	34.722	0.9627	0.9647	0.9601	0.9603	0.9656	15.8[illegible]

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CP	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3523	0.50[illegible]	0.3646	-0.0107	-0.0[illegible]56	0.0093	7.[illegible]8
2	0.0	0.0	90.00	1.3678	0.3822	0.3376	-0.0196	-0.0[illegible]60	-0.0078	11.47
3	0.0	0.0	90.00	1.3558	0.2392	0.2472	0.0016	-0.0022	-0.0128	15.8[illegible]

TABLE NO. 2-2
VAL LOW SPEED WIND TUNNEL TEST NO. 566
BALANCE AXES DATA

TUNNEL Q 9.59 — 3/ 4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 90.00 — PHI = -5.00 — RUN NO. 68

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	65.820	21.735	236.736	-0.373	-27.753	16.035
2	0.0	0.0	90.00	101.788	24.764	310.358	0.780	-4.811	-70.592
3	0.0	0.0	90.00	137.106	26.051	350.899	-1.449	-30.070	-36.491

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.82	4184.0	0.1849	14.98	4248.0	0.1821	14.93	4146.0	0.1866	14.90	4294.0	0.1802
2	0.0	0.0	90.00	24.81	5380.0	0.1438	25.01	5546.0	0.1395	24.83	5476.0	0.1413	24.68	5490.0	0.1409
3	0.0	0.0	90.00	35.00	6360.0	0.1216	34.63	6562.0	0.1179	34.48	6520.0	0.1197	34.72	6482.0	0.1194

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	17.5156	5.6974	4.6478	-0.0978	-0.1792	0.0472
2	0.0	0.0	90.00	26.6819	6.4915	6.2951	0.2045	-0.0192	-0.2077
3	0.0	0.0	90.00	35.9399	6.8289	7.2229	-0.4323	-0.0778	-0.1374

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	GS
1	0.0	0.0	90.00	14.909	0.9171	0.9118	0.9213	0.9187	0.9168	7.12
2	0.0	0.0	90.00	24.783	0.9484	0.9494	0.9573	0.9425	0.9446	11.44
3	0.0	0.0	90.00	34.706	0.9626	0.9760	0.9605	0.9563	0.9630	15.79

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.4514	0.4721	0.3851	-0.0081	-0.0066	0.0039	7.12
2	0.0	0.0	90.00	1.3755	0.3347	0.3245	0.0105	[illegible]	[illegible]	11.44
3	0.0	0.0	90.00	1.3427	0.2551	0.2698	-0.0161	[illegible]	[illegible]	15.79

TABLE NO. 2-2

VAC LOW SPEED WIND TUNNEL TEST NO. 260
BALANCE AXES DATA

TUNNEL Q 0.59 — [illegible]/ 4/68

PRESS TARE 1 — ALPHA TABLE 11

STATIC TARE 0 — TEMP TARE 1

TUNNEL TEMP 54.00 — PHI = -5.0[illegible] — RUN NO. 59

PT	ALPHA	PSI	IW	NF	AF	PM	SF	RM	YM
1	0.0	0.0	90.00	63.657	22.570	242.262	-0.419	-21.726	17.[illegible]
2	0.0	0.0	90.00	109.524	27.691	320.99[illegible]	[illegible].243	-20.514	-54.987
3	0.0	0.0	90.00	138.200	22.351	327.012	-1.03[illegible]	-35.[illegible]44	-96.[illegible]17

PT	ALPHA	PSI	IW	T1	RPM1	J1	T2	RPM2	J2	T3	RPM3	J3	T4	RPM4	J4
1	0.0	0.0	90.00	14.45	4112.0	0.1849	14.98	4232.0	[illegible].1836	14.78	4118.0	[illegible].1887	14.[illegible]	[illegible]262.[illegible]	0.1823
2	0.0	0.0	90.00	24.81	5352.0	[illegible].1452	24.44	5518.0	[illegible].14[illegible]8	24.58	5474.[illegible]	.1419	2[illegible]	5519.[illegible]	0.14[illegible]9
3	0.0	0.0	90.00	34.64	6346.0	[illegible].1224	35.05	6572.0	[illegible].1162	34.[illegible]	65[illegible]	[illegible].1195	34.07	6472.[illegible]	0.12[illegible]

WIND AXES DATA

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM
1	0.0	0.0	90.00	16.0866	5.9162	4.7386	-0.1498	-[illegible].61[illegible]	[illegible].[illegible]5[illegible]7
2	0.0	0.0	90.00	23.3500	7.2587	6.3983	0.0036	-[illegible]756	-[illegible].1619
3	0.0	0.0	90.00	36.2267	5.8589	6.6355	-0.2701	-[illegible]954	-[illegible].2937

PT	ALPHA	PSI	IW	AVE T	CTST	CTS1	CTS2	CTS3	CTS4	QS
1	0.0	0.0	90.00	14.791	[illegible].9165	0.8956	0.928[illegible]	.916[illegible]	.92[illegible]8	7.[illegible]7
2	0.0	0.0	90.00	24.704	0.9463	0.9523	[illegible].9380	[illegible].9433	[illegible].9596	11.41
3	0.0	0.0	90.00	34.614	0.9627	0.9579	[illegible].9693	0.9651	[illegible].9586	15.84

WIND AXES DATA

SLIPSTREAM Q

PT	ALPHA	PSI	IW	CL	CD	CM	CY	CRM	CYM	QS
1	0.0	0.0	90.00	1.3925	[illegible].4938	[illegible].3955	-[illegible]92	-[illegible]51	[illegible].[illegible]42	7.[illegible]7
2	0.0	0.0	90.00	1.3625	0.3753	[illegible].3316	0.0[illegible]33	-[illegible]41	-[illegible]	11.41
3	0.0	0.0	90.00	1.3495	0.2183	[illegible].2546	-[illegible].1[illegible]1	-[illegible]36	-[illegible]	15.84

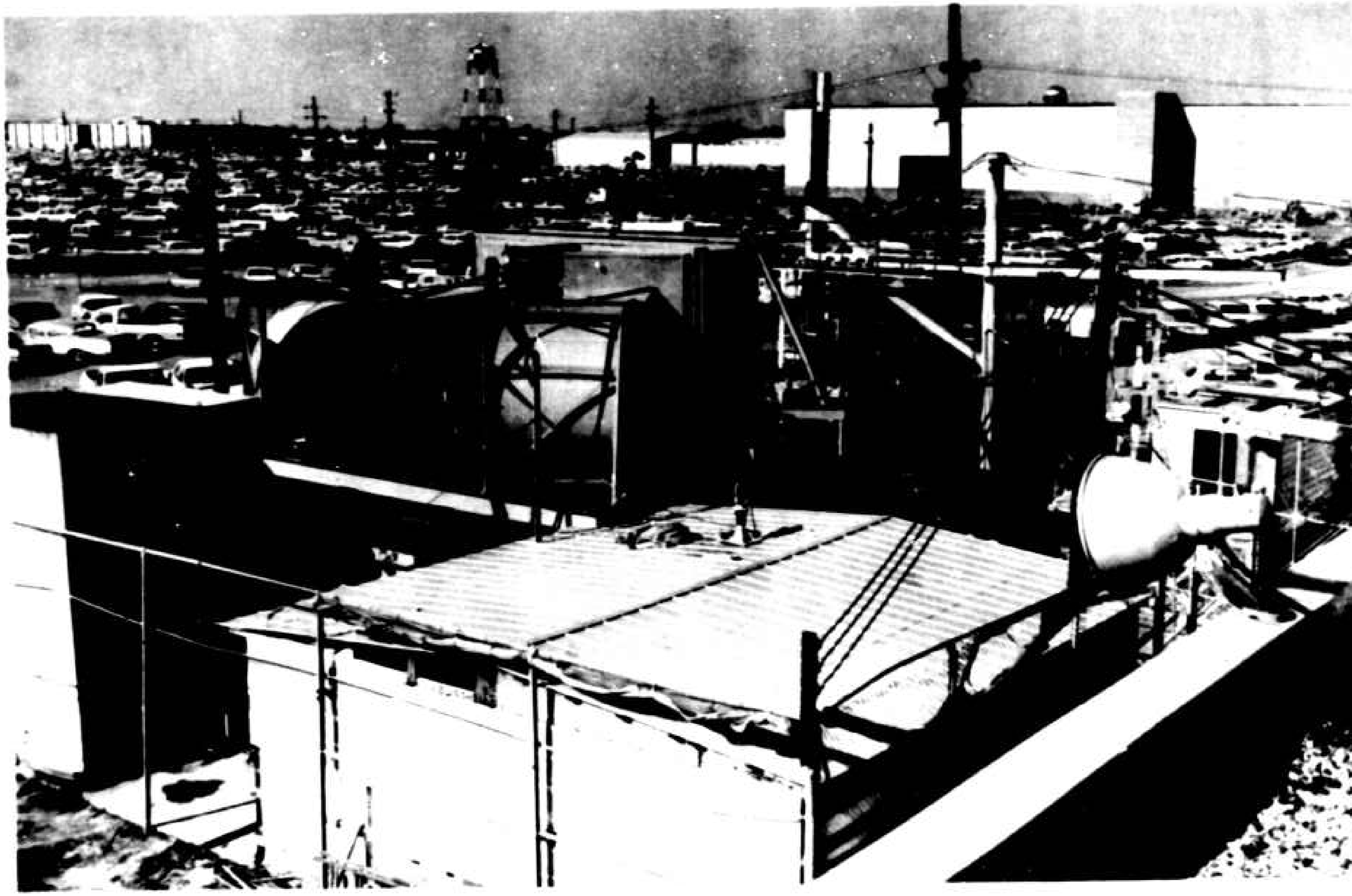

Figure 2-1 LTV Aero-Hydro Test Facility

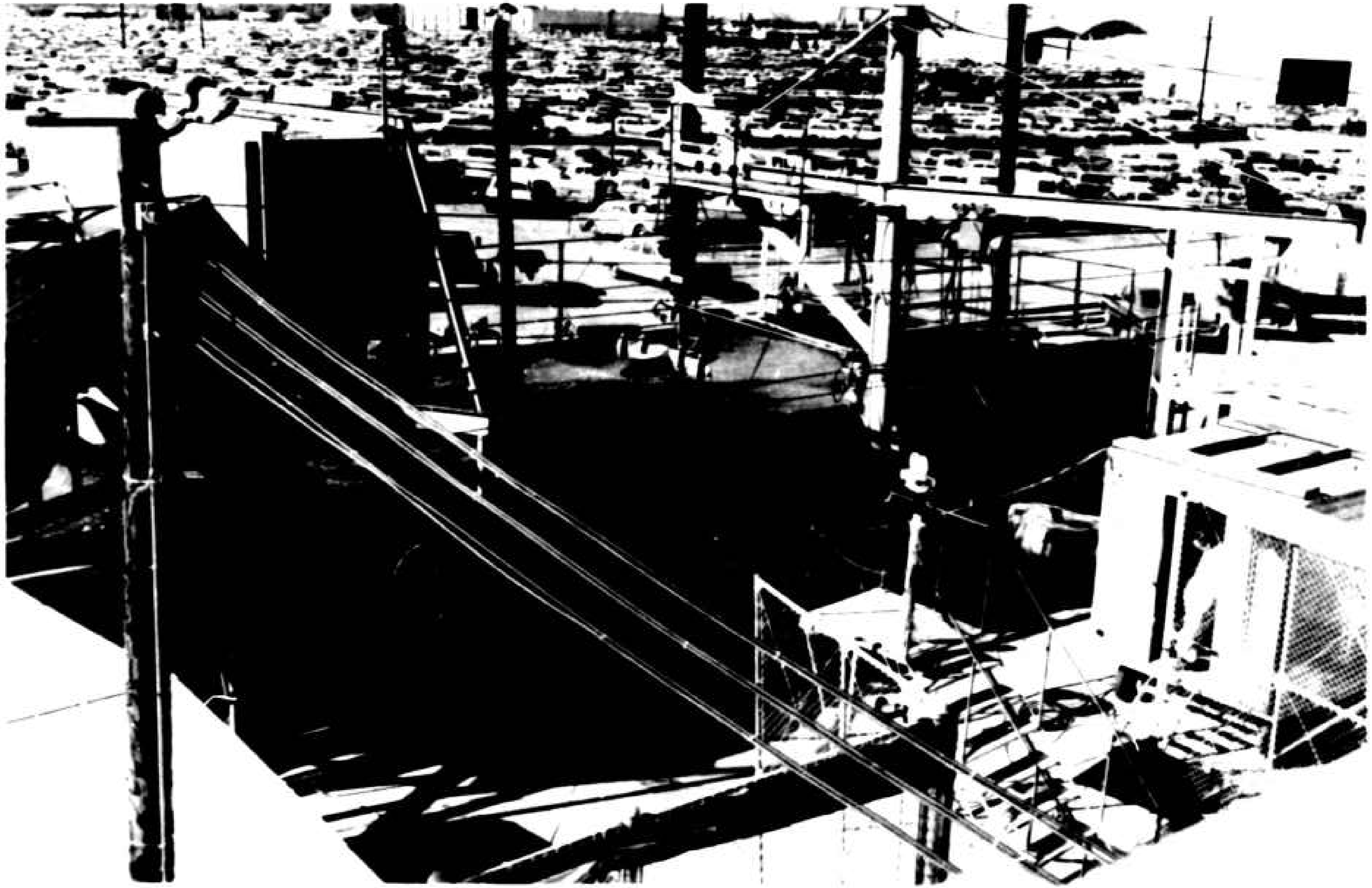

Figure 2-2 LTV Aero-Hydro Test Facility

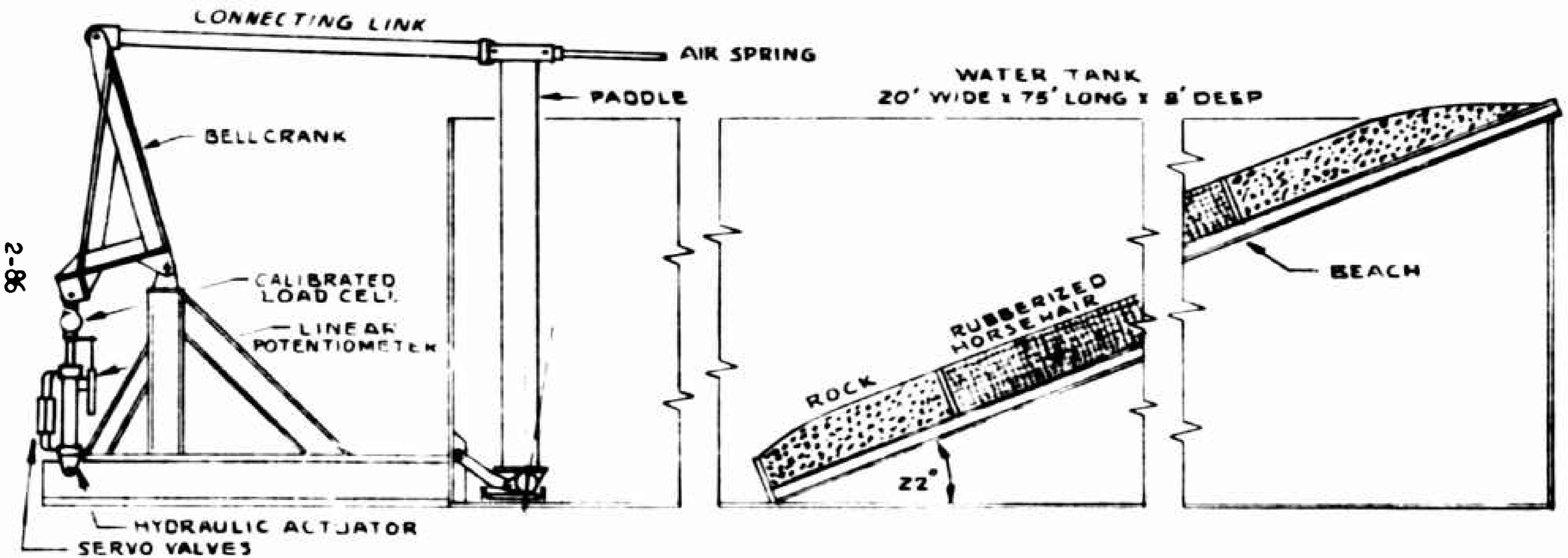

Figure 2-3 Water Tank and Wave Generator

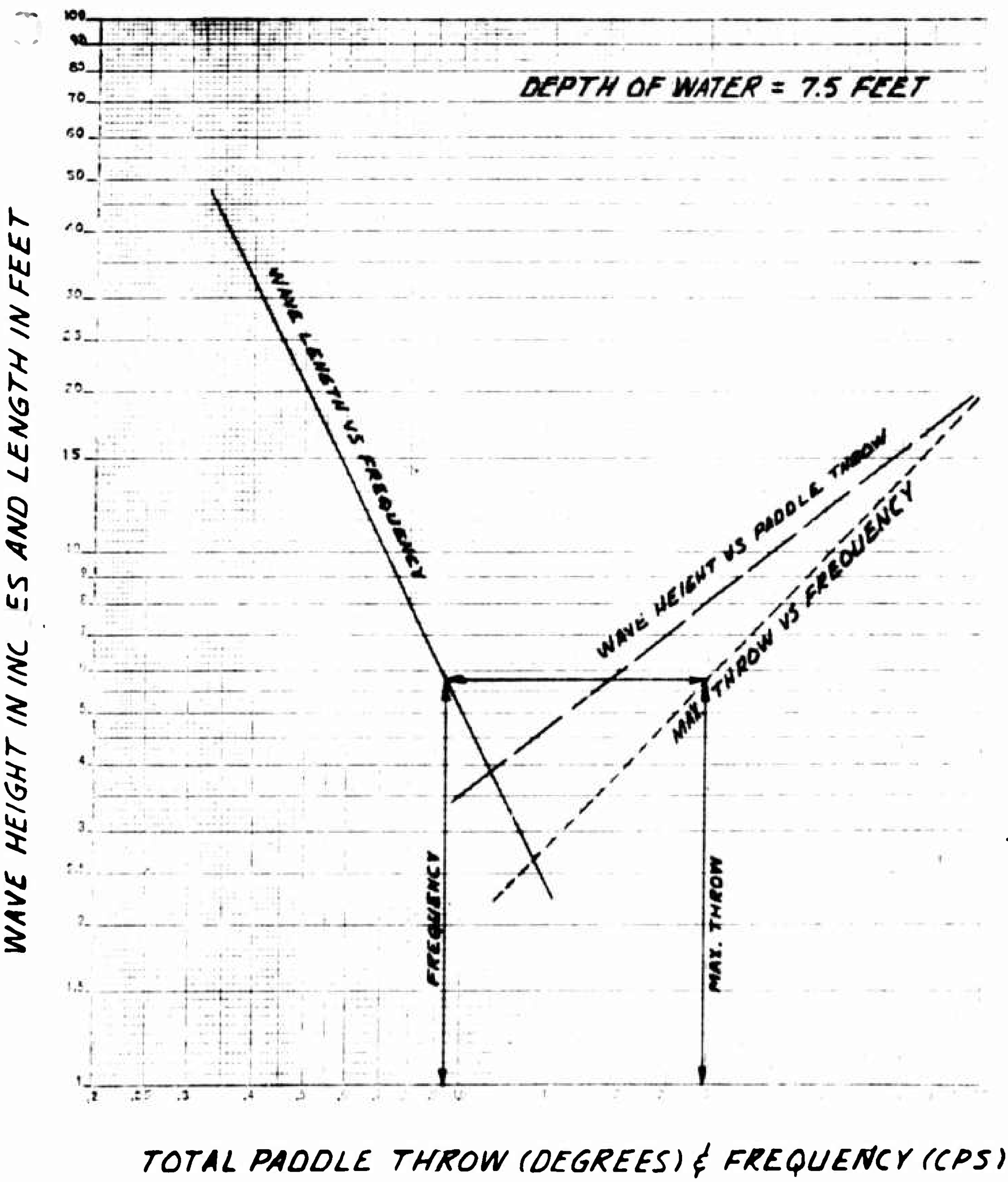

Figure 2-4 Wave Generator Calibration

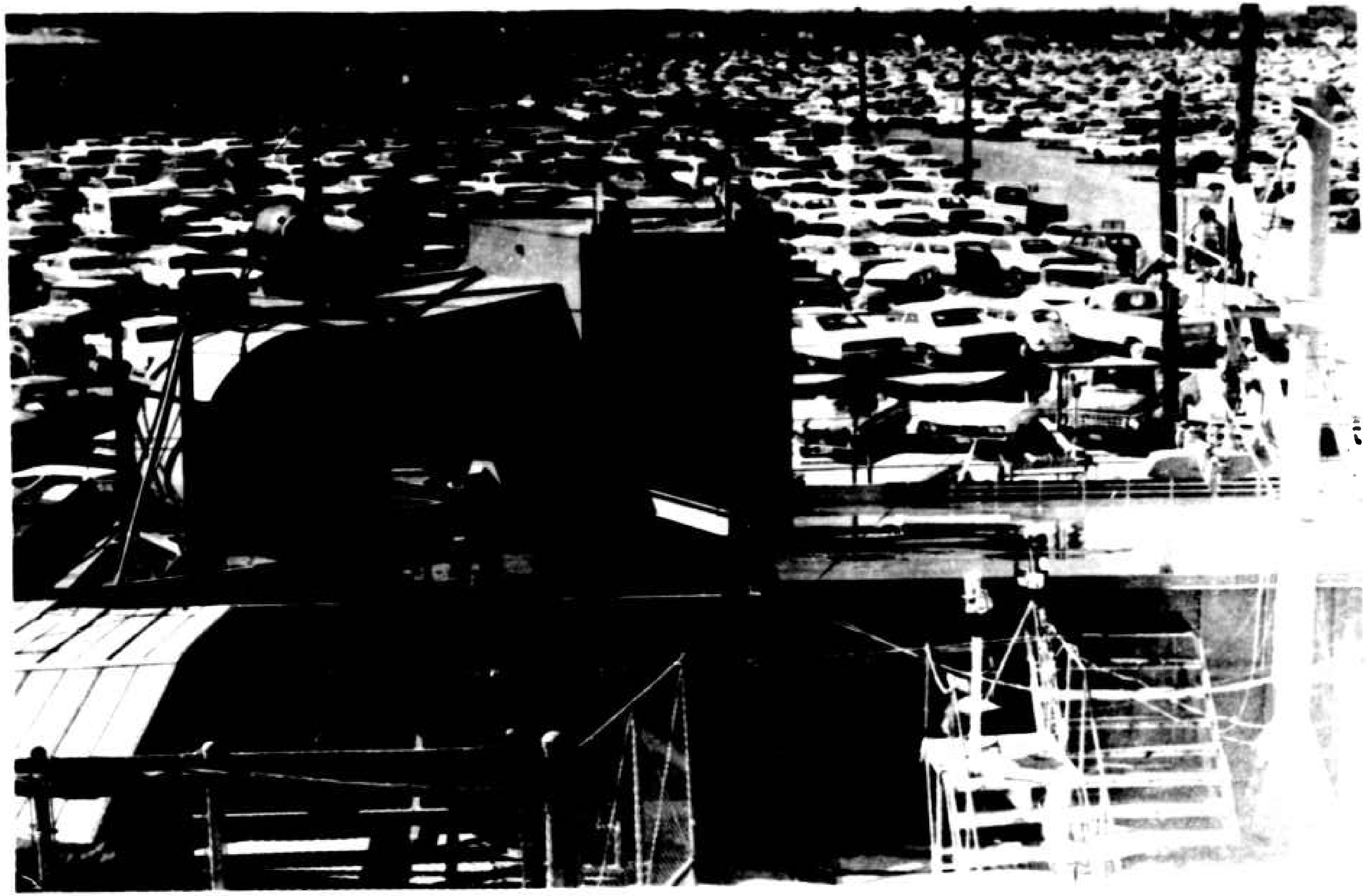

Figure 2-5 LTV Aero-Hydro Test Facility Wind Generator

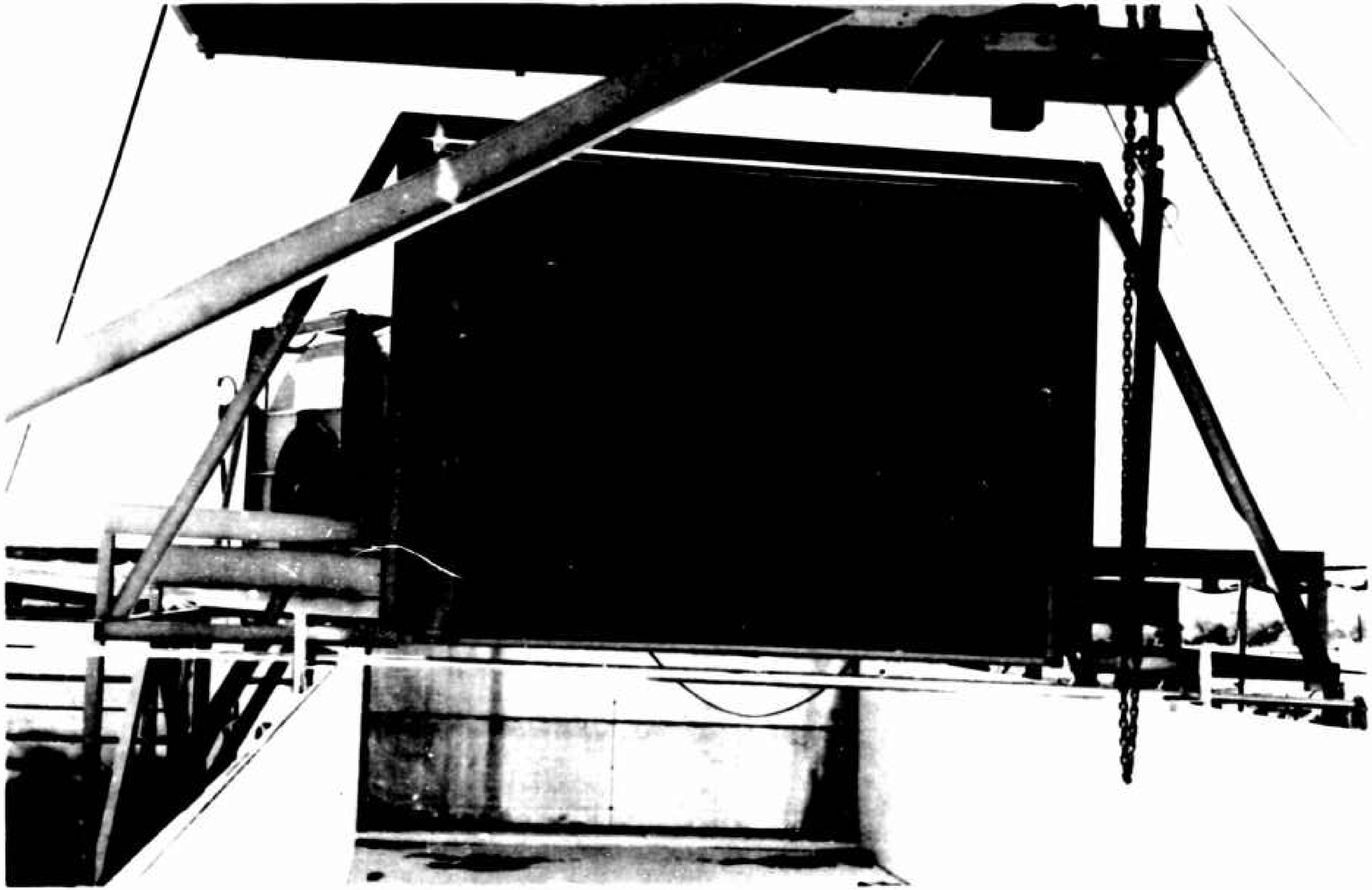

Figure 2-6 LTV Aero-Hydro Test Facility Wind Generator Plenum

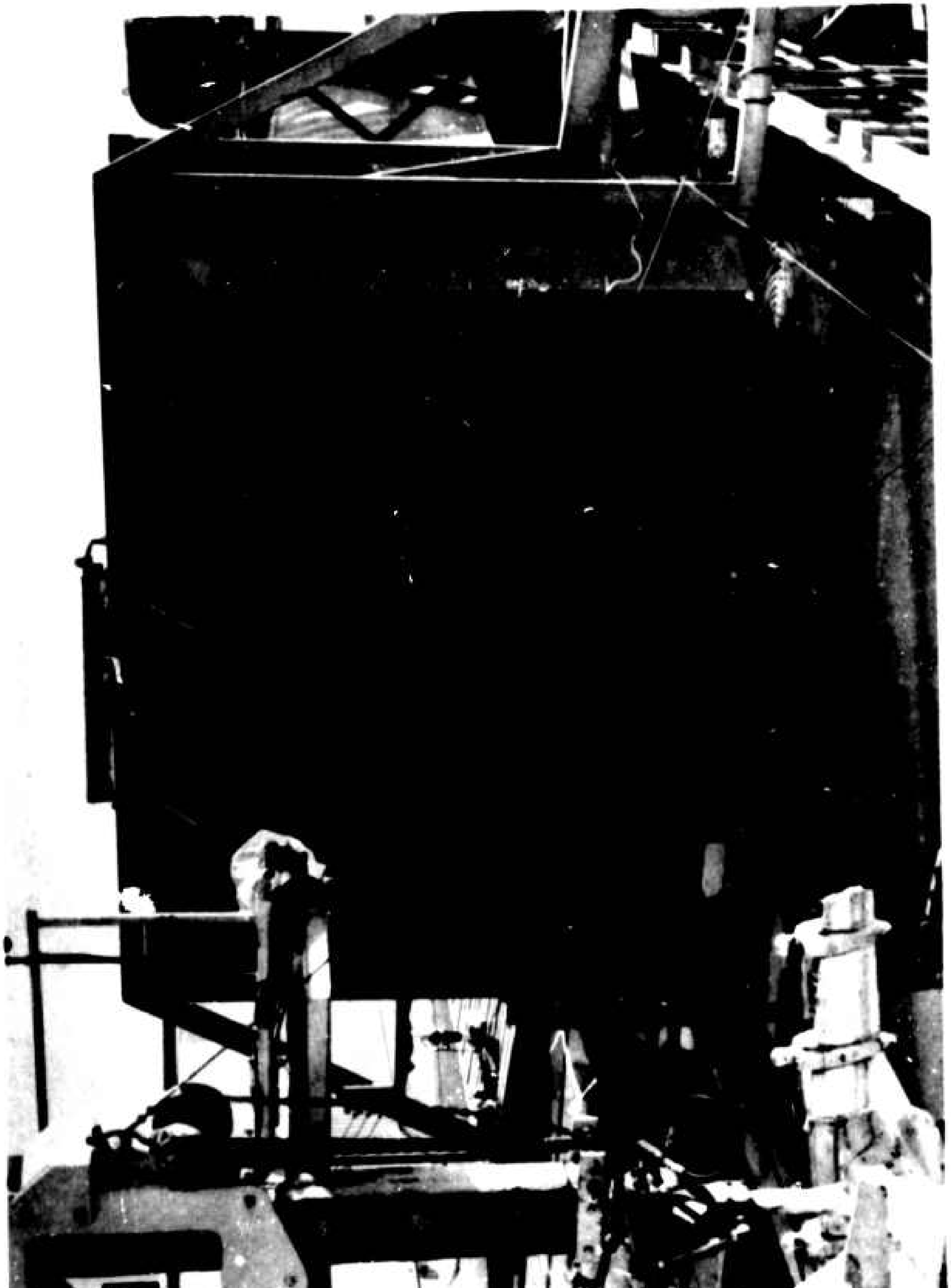

Figure 2-7 LTV Aero-Hydro Test Facility Wind Generator Diffuser Exit

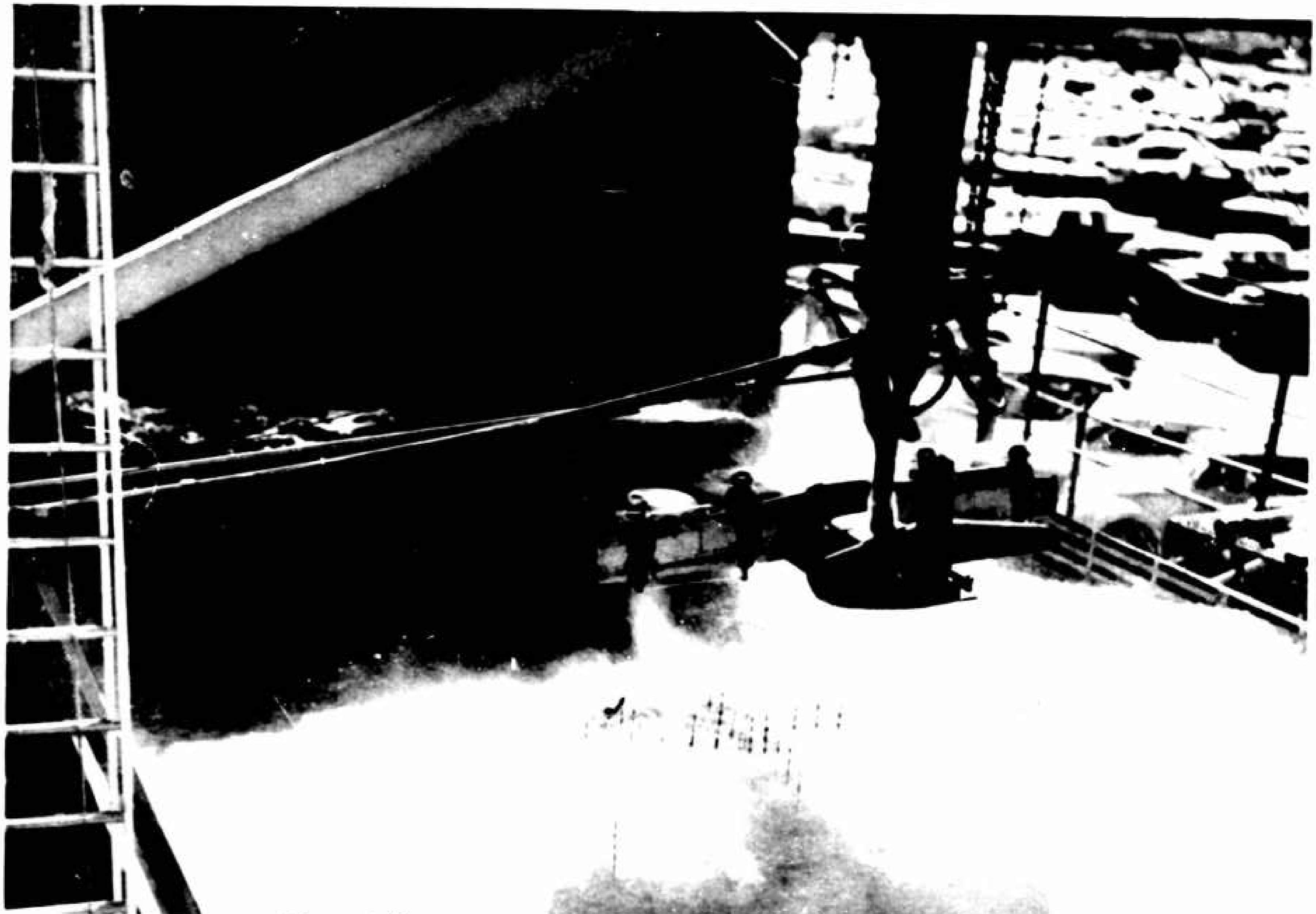

Figure 2-8 LTV Aero-Hydro Test Facility, Wind, Waves, and Spray

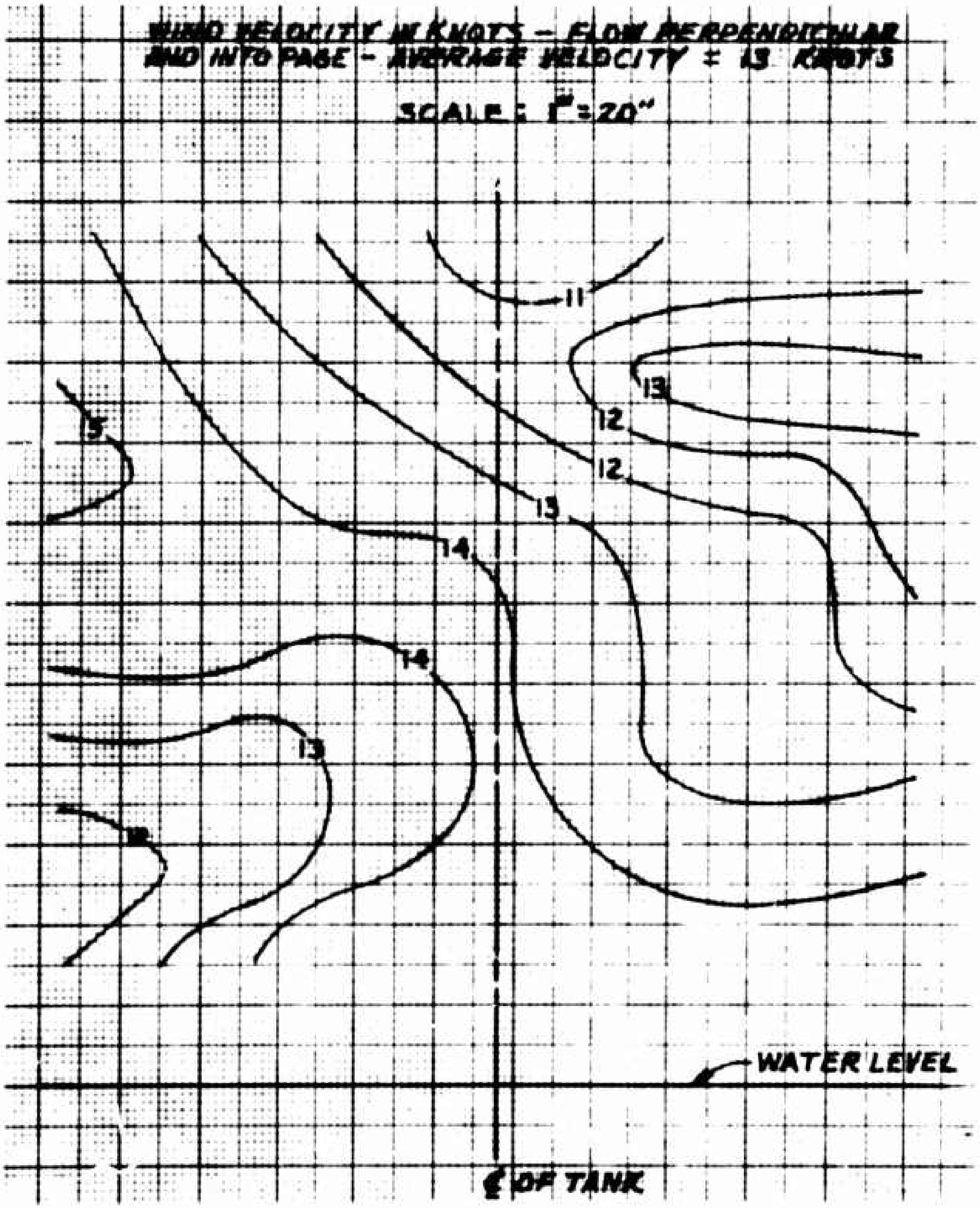

Figure 2-9 Wind Generator Calibration

3.0 FORCE AND MOMENT DATA RESULTS

The model forces and moments were measured by an internal six-component balance, and the thrust of each propeller was measured by a separate thrust cowl. The complete tabulated data are presented in Section 2.3.

The objectives of this phase of the test program were to:

a. Obtain model force and moment data while hovering at different heights over a water surface with and without waves and a steady surface wind.

b. Determine the effects of height, water surface, and surface wind on a rolled model.

Model force and moment data presented in this report have been nondimensionalized by the wing area and the slipstream dynamic pressure. The slipstream dynamic pressure is defined as the freestream dynamic pressure plus the average of the four propeller disc loadings. These data are presented as a function of model height to propeller diameter ratio for various propeller disc loadings and model roll angles with and without waves and surface winds. The model height was measured from the water surface to the propeller plane of the outboard propellers; for the rolled model, the model height is the average height to the outboard propellers measured at the propeller shafts.

The propeller disc loadings used in this test were approximately 6.5, 10.8, and 15.2 pounds per square foot. The basis for these loadings is discussed in Section 4.0.

The propeller thrust was measured with a five-component thrust cowl behind each propeller, but only the thrust component was recorded. These

thrust cowls have an accuracy of approximately ±0.25-pound thrust when the temperature tares are neglected, as was done in this test due to the wide range of ambient conditions. Thrust can be measured within ±0.1 pound under controlled conditions. Propeller rpm was measured to ±2; but under slightly gusty ambient wind conditions, the servo control system could only hold the rpm within ±6. These thrust and rpm variations represent good control of the model propeller, considering the wide range of uncontrolled ambient conditions; and only a small amount of scatter was seen in the thrust readings during the test. Model propeller controllability problems are not applicable to the full-scale airplane.

3.1 NORMAL FORCE DATA

Figures 3-1, 3-2, and 3-3 show the change in the model normal force or lift coefficient with model height ratio as a function of propeller disc loading. These data were first examined to determine the effects of various wave heights. Within the scatter of the data, the normal force coefficient was independent of wave height and surface wind. The data for 0-, 6-, and 12-inch waves were averaged together and are presented in Figures 3-1 through 3-4. The data of Figures 3-1 and 3-2 indicate that there is a small increase of the normal force coefficient as the disc loading increases and the normal force coefficient decreases with increasing model height above the water.

The variation of normal force coefficient with model height ratio for the model rolled 10 degrees is presented in Figure 3-3. At the model height ratios of 2.5 and 3.7, there is no significant change from the previous data of Figures 3-1 and 3-2. A model height ratio (2.5) was tested with the model rolled 5 degrees; and the results showed no significant differences from the data of Figure 3-3 and, therefore, have not been presented.

3.2 DRAG DATA

The change in drag coefficient with model height ratio is presented in Figures 3-1, 3-2, and 3-3. Figure 3-1 shows that, with no surface wind, there is a small effect on drag with the drag coefficient decreasing with increasing height ratios. No distinct effects of disk loading are apparent, possibly due to the scatter of the data. With the blower on, creating a steady surface wind, the data show a large increase in drag coefficient with increasing height ratio (Figure 3-2). These data also show that drag coefficient decreases with increasing disc loading. Part of the drag with surface winds shown in Figure 3-2 is the result of the propeller normal force. As the disc loading is increased, the surface wind becomes a smaller component relative to the velocity normal to the propeller disc, and the propeller normal force decreases. With the model rolled 10 degrees, the drag coefficient data of Figure 3-3 shows no significant changes from the data of Figures 3-1 and 3-2. No differences were seen at the model height ratio (2.5) with the model rolled 5 degrees, and the data are not presented.

3.3 PITCHING MOMENT DATA

The pitching moment coefficient data variations with model height ratio are presented in Figures 3-1, 3-2, and 3-3. The data of Figure 3-1 show that with no surface winds there is a small positive pitching moment acting about the center of gravity at the 20 percent MGC position that appears to be independent of model height ratio and disc loading within the scatter of the data available. With a surface wind, there is a large increase in positive pitching moment shown in Figures 3-2 and 3-3 that increases with

increasing model height ratio and decreases with increasing disc loading. This pitching moment is primarily the propeller hub pitching moment resulting from the surface wind. As was the case with the drag coefficient, as the disc loading is increased, the surface wind is a smaller component relative to the velocity normal to the propeller disc; therefore, the propeller hub pitching moment is decreased with increasing disc loading.

3.4 LATERAL-DIRECTIONAL DATA

Figure 3-4 presents the yawing moment, rolling moment, and side force coefficients with the surface wind on and off at average model height ratios of 2.5 and 3.7 for three disc loadings with XC-142A model rolled 10 degrees. The surface waves of 6 and 12 inches had no apparent effect on the data, and these points have been averaged together with the smooth surface data. Within the scatter of the data, no consistent variations with surface winds, disc loading, or model height ratio are apparent. The mean value for the yawing moment and side force coefficients appears to be zero, while the rolling moment coefficient ($C_{l_{15}}$) has a mean value of -.0075 for the left wing down 10 degrees.

3.5 VERTICAL FLOATS

The XC-142A model was tested with vertical floats replacing the landing gear wheel pods as shown in Figure 4-5 at model height ratios of 2.5 and 3.7 with and without 6-inch waves and surface winds. Within the scatter of the data, no significant differences from landing gear pods on data were seen; therefore, the float data are omitted from this report.

3.6 DYNAMIC CHARACTERISTICS

The dynamic characteristics of the No. 1 propeller thrust and the two normal force elements of the model internal balance (R_1 and R_2) were recorded on a 6-inch light beam oscillograph. These signals were picked off before they were filtered by the low speed wind tunnel data system.

Only the natural frequencies of the thrust cowl and the model were observed from these data. The frequency of the thrust element signal of the thrust cowl was observed to be from 220 to 280 cycles per second for all rpm's, model heights, and water conditions and is the approximate natural frequency of the thrust cowl (250 cycles per second). Superimposed on this thrust frequency of 250 cycles per second was an approximate eight-cycle-per-second frequency, which was also observed in the normal force gage output of the main balance. The natural frequency of the model on its hover mounting is approximately eight cycles per second in the vertical plane. These frequencies are all well within the capability of the light beam oscillograph which can record frequencies from zero to in excess of 900 cycles per second.

The amplitude of the 8 cps thrust oscillation was very large and was affected by the surface winds. Figure 3-5 presents a typical oscillograph trace for the condition of surface winds on and off. For all three disc loadings, the amplitude of the thrust oscillation varied plus and minus 10 to 15 pounds with no surface winds and plus and minus 20 to 25 pounds with the surface winds (q = 0.59). Although the surface winds approximately

doubled the amplitude of the propeller thrust oscillation, the frequencies were so high that the model data was not affected. These frequencies and amplitudes only affect the mechanical life of the thrust cowls. The various sea states simulated by the wave-maker had no apparent effect on the propeller thrust amplitude or frequency.

Six electric depth gages were positioned in the water under the model as shown in Figure 4-6 to record the amplitude and frequency of the water surface disturbances on a 6-inch light beam oscillograph. These data indicate that with the wave maker on and off the propellers generate waves with a frequency of approximately three cycles per second that move out from the model with an amplitude that is dependent on model height and disk loading. These data are presented in detail in Section 4. A typical time history of waves generated by the propellers with the wave maker off is presented in Figure 3-6. Data obtained witn the wave maker on showed the three cycles per second frequency superimposed on the wave pattern.

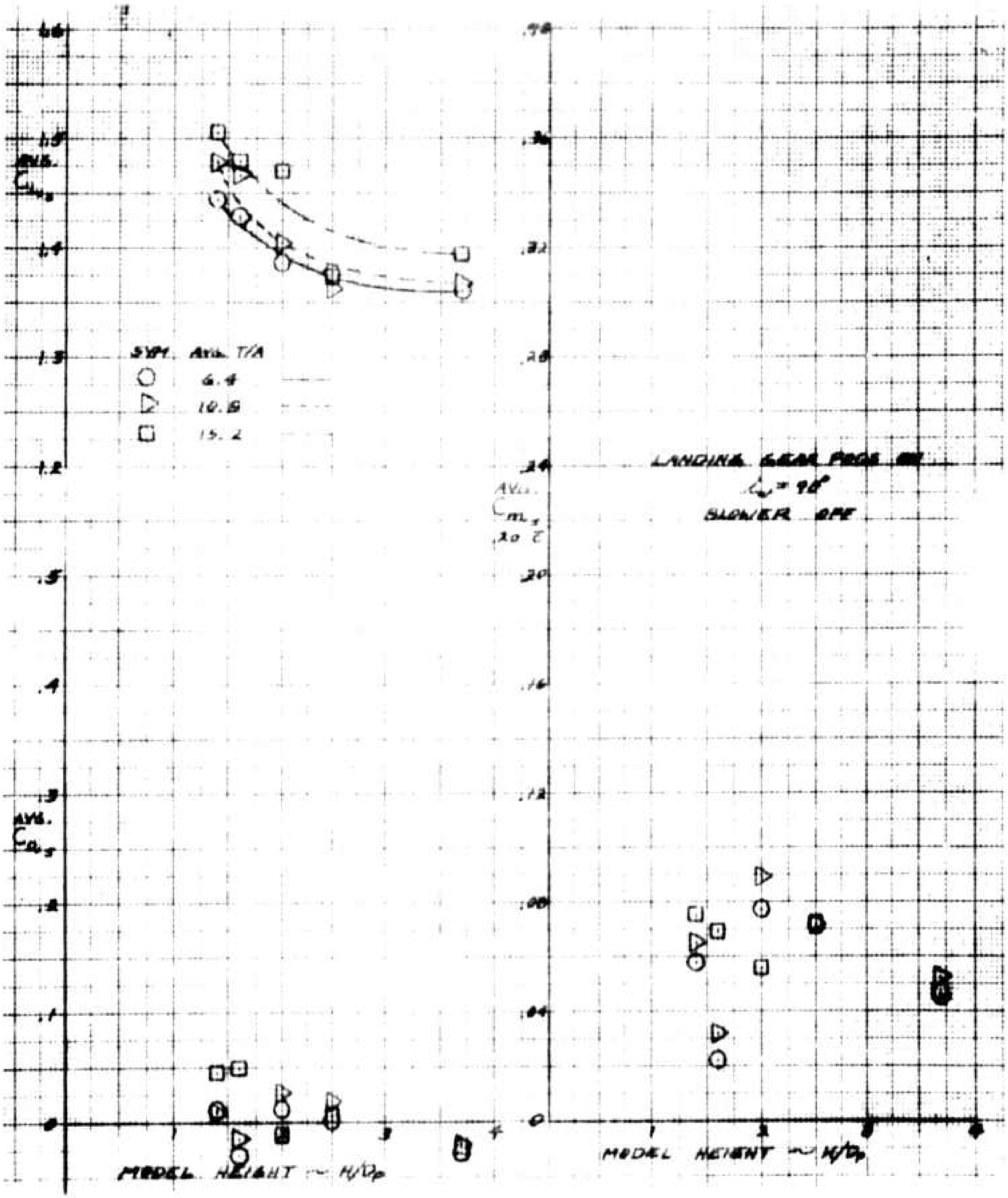

Figure 3-1 Effects of Model Height Ratio and Disc Loading on Longitudinal Characteristics

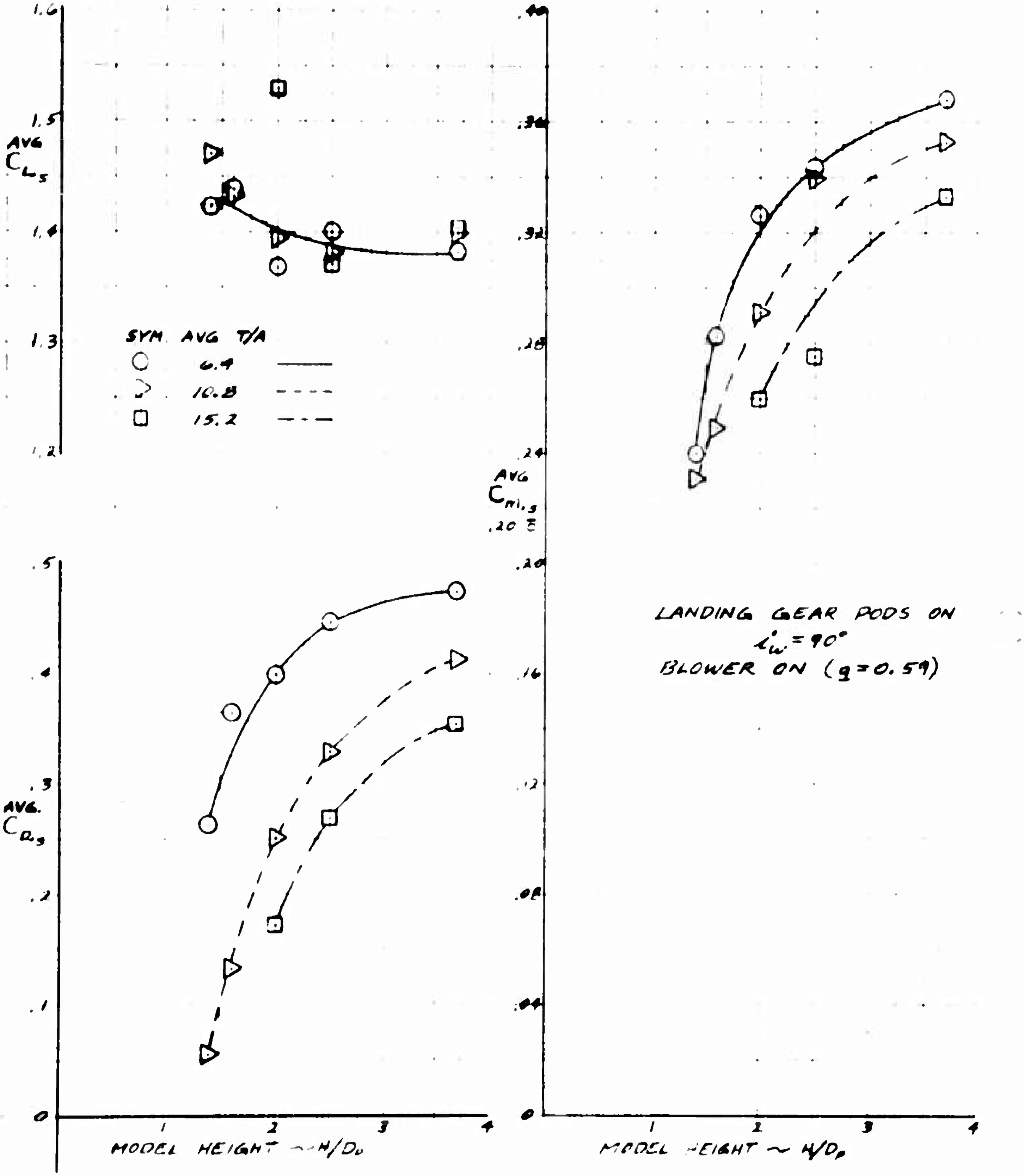

Figure 3-2 Effects of Model Height Ratio and Disc Loading on Longitudinal Characteristics

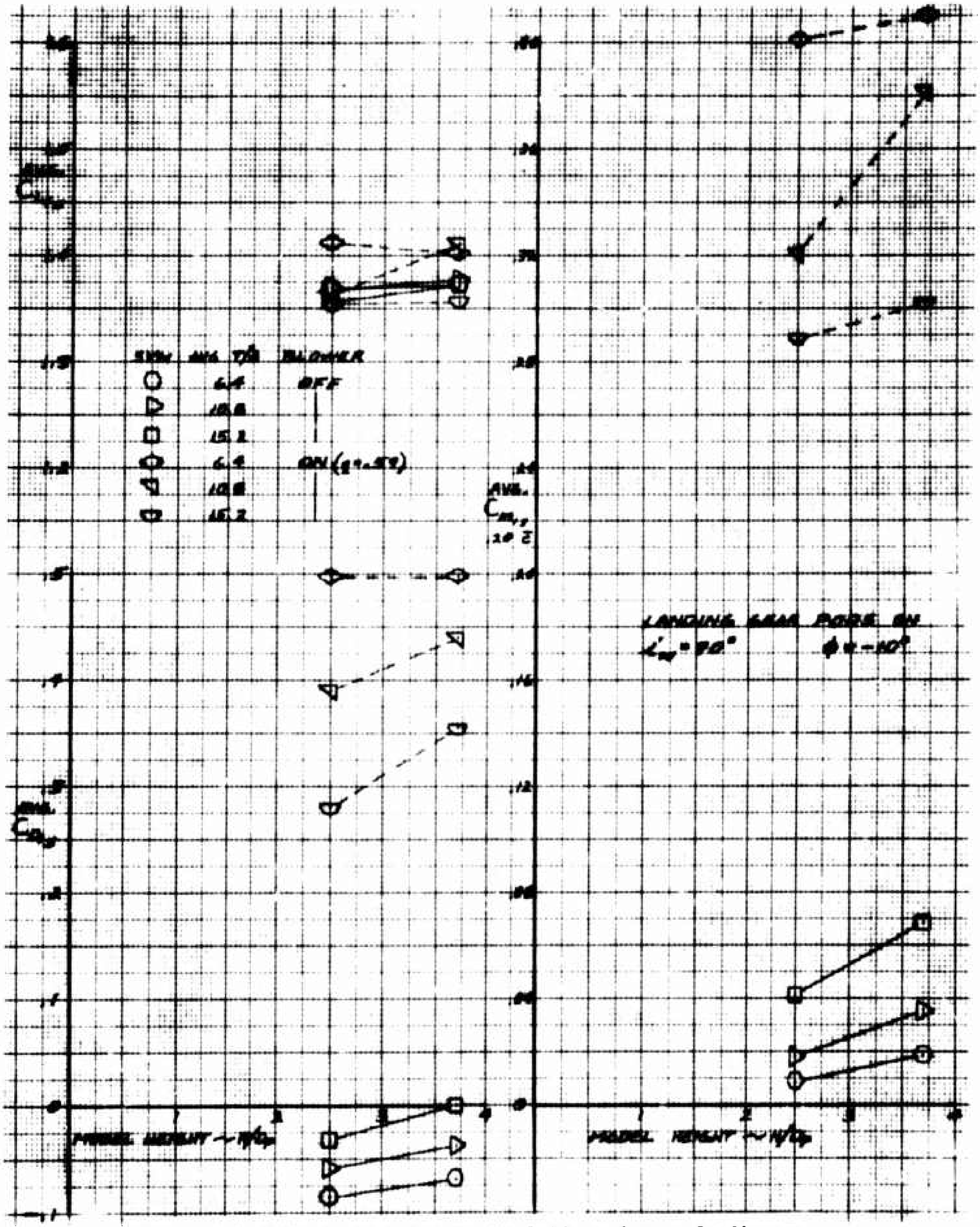

Figure 3-3 Effects of Model Height Ratio and Disc Loading on Longitudinal Characteristics

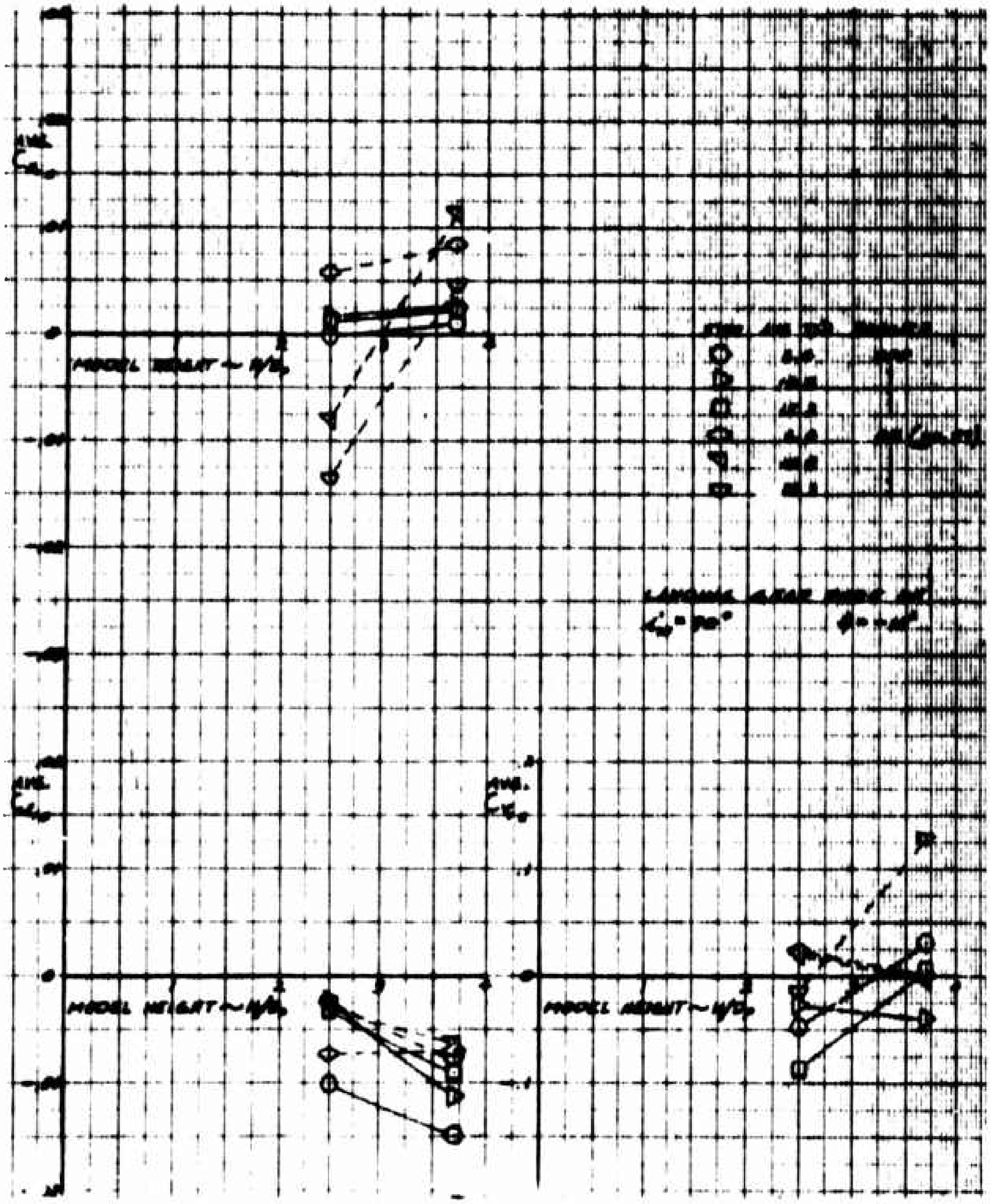

Figure 3-4 Effects of Model Height Ratio and Disc Loading on Lateral-Directional Characteristics

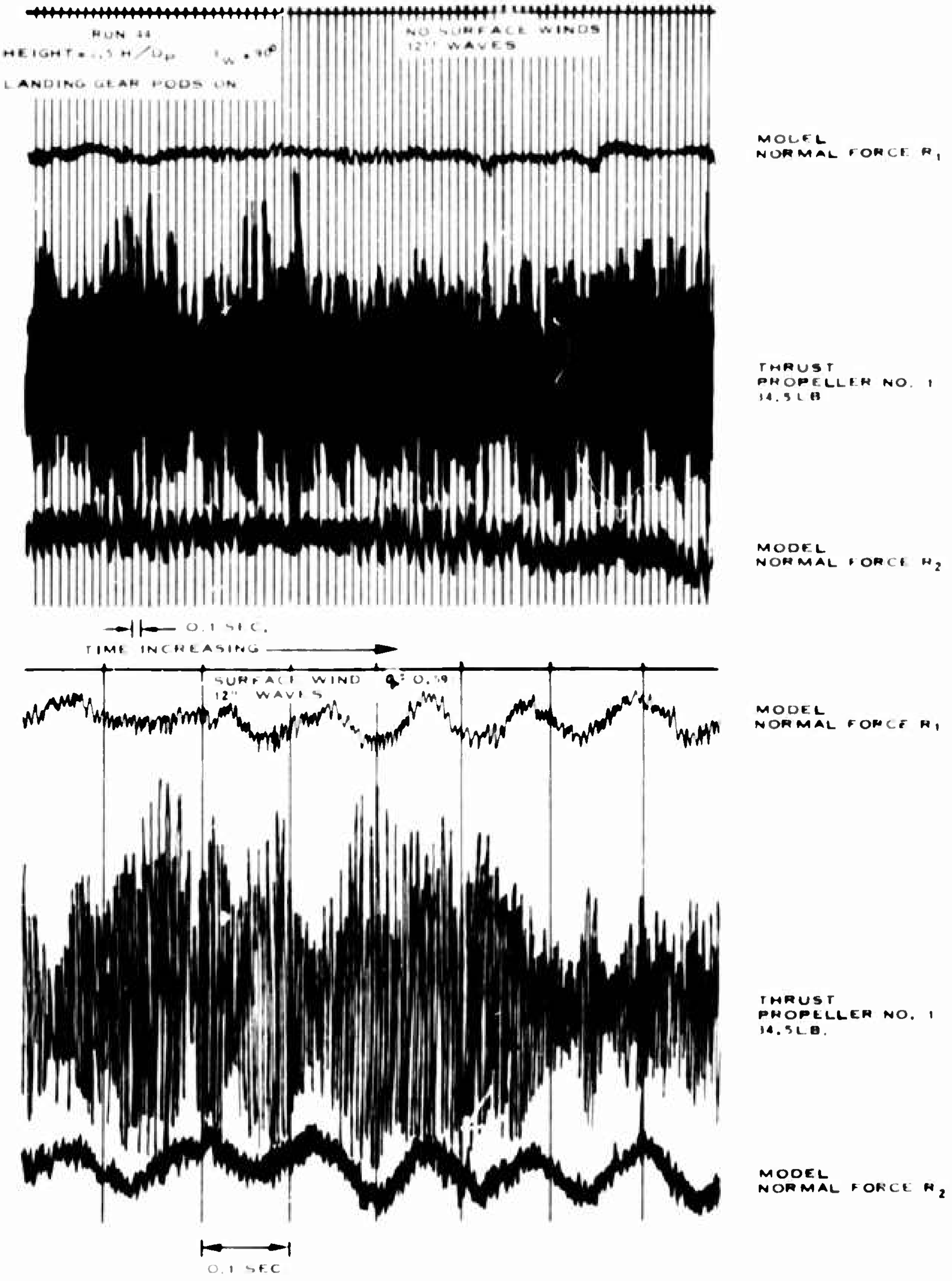

Figure 3-5 Time History of Model Normal Force and Propeller Thrust with Surface Winds On and Off

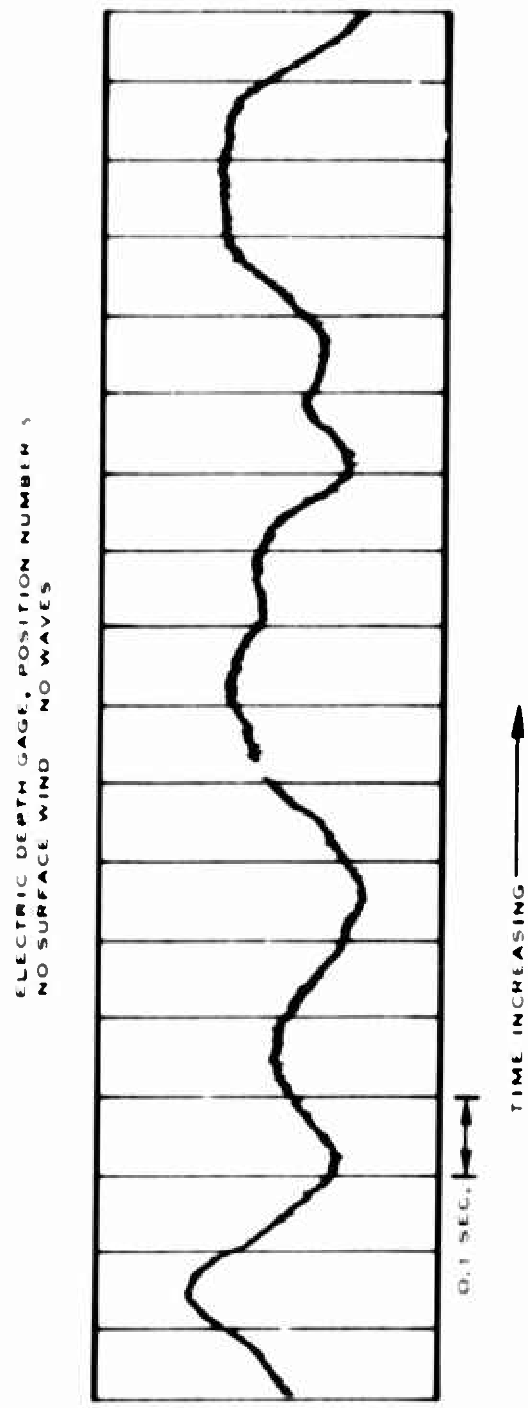

Figure 3-6 Time History of Waves Generated by Propellers with Wave-Maker Off

4.0 DOWNWASH ENVIRONMENT

4.1 INTRODUCTION

One of the objectives of this test program was the definition of environmental conditions generated by a four-engined tilt-wing vehicle using a powered .11-scale model of the XC-142 hovering over water. Primary emphasis was placed on determining the following:

a. Amount of spray passing through the propellers.

b. Shape of the depression formed by the slipstream ' the water beneath the model.

c. Size of the spray droplets.

d. General spray patterns.

For each of the above, the effects of model height, roll angle, wing angle, disc loading, wave height, wave length, ambient winds, and vertical floats were determined. The results of this test have been compared with those of other tests, some of which were with full-scale vehicles.

4.2 DATA RECORDING TECHNIQUES

4.2.1 Moisture

4.2.1.1 Water Flow Rate

Experience with seaplanes and helicopters operating near the water surface indicates that water ingestion (particularly salt water) is sufficient to be detrimental to gas turbine engine operation and life. Engine flameout occurs over fresh water with concentrations of 5%-10% by weight of water-in-air; however, salt water can cause unacceptable corrosion with concentration of one part per million (ppm) of salt-in-air (Reference 4-1). Water measurement accuracy requirements were set by the salt water criteria; individual measurements were accurate to $\pm$.00002 lb/min-in^2 (.2 ppm salt-in-air).

Two methods were attempted to record the quantity of water passing through the model propellers. The primary method was the moisture meter shown in Figure 4-1. For the previous test, conducted under contract No. N00014-66-C0095 (Reference 4-2), a single moisture meter was mounted on the left wing; for this test a moisture meter was mounted on each wing to record the unsymmetrical spray pattern created by the model in roll. The meters opened for a specified time exposing sponge-filled trays. Analytical balances, providing measurement accuracies to $\pm.002$ grams, were used to determine the amount of water collected. As a check for the moisture meters, the isokinetic probe shown in Figure 4-2 was used to sample the moisture behind the propellers. The velocity into the probe was maintained equal to the surrounding slipstream velocity by a vacuum pump. Thus an undisturbed stream of air entered the probe and was filtered for analysis. The filter portion of the isokinetic probe weighed over a pound, and, as a consequence, was too heavy to weigh on available scales having sufficient accuracy. As a result, no useful data was acquired from the isokinetic probe. The locations of the moisture meter trays and the isokinetic probe are shown in Figure 4-3.

4.2.1.2 Droplet Size

The size of the droplets in a flow field determines the ability of the spray to follow air currents; light spray and aerosols follow the airstream, while larger droplets tend to precipitate. Previous investigations with various size models with scaled disc loadings (References 4-3 and 4-4) indicated that a finer mist was generated by the larger models. Droplet sizes were recorded to determine if the droplets created by the present test were too large to follow the airstream and to provide a base for comparison with full-scale tests.

Two types of instrumentation were used to determine droplet sizes for this test. Pictures of droplets down to 40 microns in diameter were taken from 13 feet away using the 40-inch lens mounted on a camera. Another method using a device known as a droplet snatcher (Figure 4-4) was also employed to measure droplet size. Glass slides coated with light (SG = .972) over heavy (SG = 1.11) silicone fluids were inserted in the droplet snatcher, exposed to the spray for 1 to 2 seconds, and photographed under a microscope. The droplets were suspended at the interface between the two fluids. The smallest droplets that could be detected were 9 microns in diameter, while the largest that could be captured without shattering were 1,250 microns.

4.2.2 Water Depression

The slope of the depression formed by the slipstream in the water beneath the model influences the amount of spray circulation. The vertical component of the spray leaving the water is determined by the slope of the water near the depression lip. The amount of spray generated is determined by the size of the wavelets formed in the depression.

Two methods of recording depression characteristics were employed: (a) motion pictures of the visual depth gages shown in Figure 4-5; and (b) oscillograph traces from electrical depth gages. An instantaneous depression contour was obtained from a given movie frame; time variations at a given point were obtained from the electrical depth gages. Visual depth gage readings were checked for accuracy by comparisons between various readings for still water and comparisons of these readings with actual measurements of the gages. These comparisons indicated that the average reading was within .3 inch of the actual depth. The accuracy of the electrical depth gages was within .1 inch, except where limited by the small scale require record

16-inch waves on 6-inch oscillograph paper. The depth gage pattern presented in Figure 4-6 shows the following types of depth gages:

a. Visual depth gages from the previous test (Reference 4-2).

b. Redesigned visual depth gages constructed for this test.

c. Electrical depth gages.

4.2.3 Qualitative Observations

Observations of flow patterns and related data were made visually during the test and recorded with standard and high speed movie cameras. A Photosonics movie camera at 500 frames per second and a Milliken movie camera at 100 and 400 frames per second provided high speed motion picture coverage.

4.3 TEST RESULTS

The following range of parameters were investigated in the test:

Disc Loading = 6.45, 10.8, and 15.45 PSF

Model Height = 1.4, 1.6, 2.0, 2.5, and 3.7 propeller diameters

Wing Incidence Angle = 70, 75, 80, 85, and 90 degrees

Model Roll Angle = 0, 5, and 10 degrees

Vertical Floats: on and off

Wave Height = 0, 6, and 12 inches

Wave Length-to-Height Ratio = 10 and 15

Wind: off and on (13 knot headwind)

An additional test parameter was ambient winds. The wind generator was directly in front and due south of the model as shown in Figure 4-7; consequently, wind-on runs were usually conducted when the wind exceeded 8 knots only if the wind was from the south, since a south wind was found to have a minimum effect on wind generator flow characteristics. Testing was generally terminated when the wind exceeded 8 knots from any other direction.

A standard format has been adapted for each of the four types of data presented in the following sections:

a. The moisture meter data, tabulated in terms of lb/min-in.^{2}, is presented in Table 4-1. This information is presented graphically in terms of spray circulation profiles along the wing and comparisons between averages of all the moisture trays for a given condition.

b. Contours beneath the wings, fore and aft beneath each nacelle, and topographical maps of the water depression have been prepared from visual depth gage data.

c. Depth variation with time at a given point is recorded by the electrical depth gages.

d. Droplet photographs were used to prepare droplet size distribution curves.

4.3.1 Flow Field Description

Wind and waves complicate the already complex flow field generated by a tilt-wing aircraft with four propellers hovering over water. There are interactions between neighboring propeller slipstreams, and between individual propeller slipstreams and the wind, the waves, and the fuselage. These interactions over deep water generate a flow field that never reaches a steady state.

The basic flow pattern without waves beneath the model is shown in Figure 4-7. The two propeller slipstreams on each wing coalesce to form a single depression beneath each wing. The two coalesced jets of air met beneath the fuselage to produce a "fountain effect," which was responsible for the majority of spray generated at any test condition. This reinforced flow

area carried the spray fore and aft beneath the fuselage and up onto the bottom of fuselage. Movies from the previous test (Reference 4-2) indicate that, when fuselage blockage is not available, the spray is carried into the area of the propellers. There is virtually no additional spray formed between adjacent propellers due to their overlap.

In still water, wavelets are formed at the bottom of each depression and increase in amplitude as they progress up the sides of the depression. For mild spray conditions, spray is formed along the rim of the depression as each wavelet reaches the rim (Figure 4-7). Spray is formed on the crest of each wavelet at severe spray conditions. The depression shape and location varies continuously in a random manner.

The wave-slipstream interactions with 6-inch wave patterns as a function of slowly increasing model disc loading at a given model height lead to the following four observations:

a. Below 6.4 psf, the wave velocity decreases at the center of the wave forcing the wave crestline into an arc.

b. Increasing the disc loading forces the wave crest into a chevron with the peak upstream of the model. This creates essentially two wave patterns that meet and form 10- to 12-inch unstable mounds of water immediately forward of the fuselage. The tops of these mounds are carried away, creating dense spray. Only near the tank sidewalls did the wave pattern pass the model. There is a 2- to 4-inch high wave pattern aft of the model.

c. Still further increases in disc loading transformed the area forward of the model into a confused sea with waves 12 to 14

inches high. The slipstream completely destroys the wave pattern, leaving only ripples downstream of the model.

d. Because of the cross waves set up by the model, an acceptable wave train could not be established in less than 5 minutes after termination.

The 12-inch waves contained more energy; consequently, they were not destroyed by the slipstream. A depression was formed, and, at high disc loadings, spray was driven up the advancing side of the wave; and the wave crest was transformed into spray.

Actuation of the wind generator forced the forward-driven spray to form a vertical wall, and then rolled it back toward the model. Since the model support system was stiffened prior to this test, the model did not sway as it did in the previous test with the wind off. However, the wind generator and model dynamics were sufficient to cause sway in the stiffened support system with the wind on.

The intermediate disc loading of 10.82 psf was equal to the highest disc loading on the previous test. The highest disc loading (15.45 psf) run in this test was responsible for considerable propeller damage. The right inboard propeller (No. 3) was subject to most of the damage, with the right outboard propeller (No. 4) a close second. After 49 runs, two propellers had eroded severely in the No. 3 position. Because of this problem, the high disc loading testing at low heights was minimized because of possible propeller damage. In addition, one propeller was coated with a VAD-developed neoprene coating and installed in the No. 3 position. A photograph of this propeller is shown in Figure 4-8 prior to installation. A short time later, a new uncoated propeller was installed in the No. 4 position and at the end of the test, approximately 21 hours of running time for each propeller, the new

propeller was severely damaged (Figure 4-9) while the coated propeller was only slightly pitted (Figure 4-10). This coating is thus considered very effective in protecting surfaces from water erosion under conditions similar to those experienced by a propeller blade.

4.3.2 Repeatability and Sidewall Effects

The tank was full of water during the first four runs of this test. For the remaining runs, the water level was maintained 7 inches below the tank low point (the tank low point was 2 inches below the sides of the test section) to provide sufficient room to generate 12-inch waves. These four initial runs provide a comparison with the previous test (Reference 4-2) and show sidewall effects when compared with later runs. The tank sidewalls were close enough to the model to provide some flow blockage (Figure 4-11) that slightly increased the depression depth and the amount of spray circulation. However, since 20 minutes are required to change the water level 1 inch, it was not considered worthwhile to change water level between runs to minimize this interference effect.

The ability to repeat a given result is very important for this type of test. Figure 4-12 shows data from four separate runs from this test and one from the previous test. Movies of the earlier test indicate that the fountain effect was allowed to periodically escape fuselage blockage at this height by the swaying motion of the model. This probably accounts for the larger spray circulation for the previous test. From Figure 4-12, it appears that the moisture meter data for this test can be repeated within .0005 lb/min per sq inch.

Moisture meter data and propeller erosion indicated that the right wing of the model experienced more spray recirculation than the left.

This may have been caused by a camera platform (Figure 2-2) some distance above the left wing.

The importance of tank sidewall blockage at high disc loadings is shown in Figure 4-13, where approximately seven times as much water was trapped at the lower water level as with the tank full. While Figure 4-13 shows a small increase in spray circulation at the intermediate disc loading, the influence of the sidewalls became more pronounced as the model was lowered. At the lowest model height tested (H/D = 1.4), the intermediate disc loading also shows a sevenfold increase in spray circulation with sidewalls (Table 4-1).

The shape of the water depressions for this test is compared with similar data from the previous test in Figures 4-14 and 4-15. Reasonable agreement was shown with the tank full. Complete agreement could not be expected, since depth is a function of time (Figure 4-16), and there is no way to synchronize the two tests. The effects of sidewalls on depression shape are presented in Figures 4-14 and 4-15. The sidewall blockage apparently gives deeper depressions beneath the propellers. The data presented in the following sections include the effects of the 7-inch sidewalls.

4.3.3 Effects of Important Parameters

4.3.3.1 Time

When an air mass, accelerated by a propeller, strikes the water surface, an inherently unstable condition is the result. Electrical depth gages were used to measure the time variations of the water surface beneath the model. A number of typical electric depth gage traces are presented in Figure 4-16. The axis of abscissa was arbitrarily placed in the center of the trace to provide a direct comparison between disc loadings and reflects depth

variations about a given point and not the absolute displacement. The smallest wavelets at each disc loading were recorded on gages 18 and 22 located near the center of the depression and directly beneath the propellers (Figure 4-6). The growth of the wavelets as they move up the sides of the depression can be determined by a comparison of gages 22, 35, and 32. The basic frequency of the wavelets is approximately three cycles per second. Some subsequent sections present water contours beneath the model at a given instant. It should be emphasized that these are subject to considerable variations with time.

4.3.3.2 Model Height

Model height was measured from the water surface to the average of the outboard propeller centerlines and expressed as height divided by propeller diameter (H/D). Table 4-2 presents the full-scale heights, disc loadings, wave heights, and wind speeds for the model conditions tested. These data can be compared with sea state definitions presented in Table 4-3 to obtain equivalent full-scale sea states.

Since air velocities near the water surface increase as the model is lowered (Reference 4-5), additional spray was formed and circulated. Figures 4-17 and 4-18 present the increased circulation with model height reduction for the intermediate and high disc loadings respectively. The effects of waves, wind, and height are presented in Figure 4-19 for the intermediate disc loading. The increase of spray circulation as height decreases is a minimum without wind or waves. It increases with the addition of 6-inch waves and no surface wind. It increases far more with the addition of the 13 knot surface wind and no waves. The spray circulation is most pronounced with both wind and waves. As shown by comparison of Figure 4-20 to Figure 4-19,

increasing the disc loading increased the amount of water flowing through the propellers at any given height.

Reducing model height increased depression depth, as seen in Figures 4-21 through 4-28, due to an increase in static pressure beneath the propellers (Reference 4-5). Figures 4-21 and 4-22 present complete sets of contours beneath the left wing at a given instant for a certain height. The following sets are taken at four frame intervals (1/6 second) to account for time variations. In the following sections only one set of typical data will be presented.

4.3.3.3 Disc Loading

Increasing disc loading increases the amount of spray for given test condition as shown in Figures 4-29, 4-30, and 4-31. Figure 4-32 presents the increased spray circulation caused by increased disc loading as measured by the individual trays. The interactions of wind, waves, and disc loading in relation to spray circulation are examined in Figure 4-33. It was found that the amount of water trapped increases much more rapidly with increasing disc loading when wind and/or waves are present. The destruction of 6-inch waves by the high disc loading in the presence of wind generated the most spray circulation.

Figures 4-34 and 4-35 present the change in depression shape and depth as the disc loading is increased. Only with the model in the highest position was it practical to read the visual depth gages for the 15.45 psf disc loading.

4.3.3.4 Wing Angle

A series of runs was conducted with the wind on and various wing positions at a model height (H/D) of 3.7. Previous tests (Reference 4-6)

indicated that a tilt wing, four-propeller STOL has much more water circulation than VTOL when they are waterborne. The STOL slipstream carried spray forward of the craft, and the propellers drew the spray back toward the craft. This series of runs was conducted to determine if this same principle would apply to a VTOL vehicle hovering in a headwind. At this height the headwind tends to blow the spray back beneath the model before it reaches the area of the propellers. Decreasing the wing angle below 80° helped the wind to blow the spray aft, giving a marked reduction in the amount of spray trapped (Figure 4-36). Contributing to this reduction of spray circulation was the movement of the depression to the rear as wing angle was reduced (Figures 4-37 and 4-38).

4.3.3.5 Wind

The dramatic increase in spray circulation, attributable to wind, has been discussed in the previous sections with relation to model height and disc loading. The wind does not generate spray; however, it will roll slipstream-generated spray back over the model. This effect is demonstrated in Figure 4-39 where more water is trapped at the lower model heights where more spray is generated. The effect of wind on spray circulation may have been influenced by the swaying of the model and sting during wind-on runs, although the magnitude of this effect could not be assessed.

The influence of wind on depression, presented in Figures 4-40 and 4-41, indicates that the primary effect of wind was to move the depression aft. As would be expected, the lower disc loading depressions were moved the farthest aft.

4.3.3.6 Waves

Wave heights of 6 and 12 inches were tested which, along with the still water data, present a three-point comparison. Scaled wave heights and lengths shown in Table 4-2 were determined by assuming that they were proportional to the propeller diameter. The effect of wave height on the amount of spray trapped is shown in Figure 4-42. Both wave heights increased spray circulation. The small waves probably increased the spray circulation by their instability, and the large ones probably because their tops pass closer to the model. The average of the moisture trapped at all stations shows interesting trends at various wave heights (Figure 4-43). With the wind off, the spray circulation was greatest with the 12-inch wave height; with the wind on, the unstable 6-inch waves caused the most spray circulation. Wave length-to-height ratios of 10 and 15 were tested; the shorter waves were less stable, causing an increased spray circulation as shown in Figure 4.44. The shorter wave length decreased the wave-maker reliability; therefore, the majority of the testing was conducted at the longer wave length.

Providing valid data when waves are present is a major problem in using visual depth gages. The source of the problem is the difficulty of stopping two moving waves in precisely the same phase for comparison. The available data was examined until frames with the waves in the same phase were found, and only then could such a comparison be made. A wave height comparison is presented in Figures 4-45 to 4-47. The instability of the 6-inch waves is highlighted by Figure 4-45, since the waves are in phase per Figures 4-46 and 4-47. Wind and model height effects are presented in the next three curves (Figures 4-48 to 4-50). The lower the model height, the greater the disruptive effects of the downwash on wave pattern.

Since visual depth gage data is not entirely satisfactory when waves were present, additional data from the electrical depth gages is presented in Figures 4-51 to 4-54. Information from rolled configurations is presented, since the electrical gages were not completely operational until late in the test program. Data for 6-inch waves are presented in Figures 4-51 and 4-52. Gage 28 is 40 inches forward of the model and, although it reflects some influence of the slipstream disturbance, the trace basically represents an undisturbed wave. The wave properties directly beneath the left inboard and outboard propellers are presented by gages 18 and 22 respectively; these traces show that the wave pattern has been depressed in this area. A comparison of gage 44, which is forward of the depression, and gage 35, which is aft of the depression, shows increased wave destruction as disc loading is increased. Twelve-inch wave properties for a typical run are presented in Figures 4-53 and 4-54. Gages 18 and 22 show the basic depressed wave shape in the stagnation region directly beneath the propellers. In the flow turning region, approximately one propeller diameter from the stagnation point, the flow velocity increases as the static pressure decreases. The increasing wave disturbance, as the velocity increases, is shown by a comparison of gage 32 with gages 35 and 44.

4.3.3.7 Roll Angle

The model was rolled with the left wing down to determine the effects of this configuration on spray circulation. Previous tests (Reference 4-2) indicated that severe spray circulation could be generated with a 10° roll and a model height (H/D) of one. During this earlier test, roll and model sway allowed the fountain effect to periodically escape fuselage blockage and enter the region of the right-hand propellers. However, it was shown that spray circulation dropped off rapidly as the model was raised.

This test covered the higher model positions ($2 \le H/D \le 3.7$) and showed that rolling the model at these conditions dropped spray circulation (Figures 4-55 and 4-56). The model did not generate a strong fountain effect at the heights tested; consequently, rolling the model had the same effect as decreasing wing incidence angle; i.e., the spray was blown away from the model by the slipstream. Even at the highest disc loading, the slipstream struck the right tank sidewall with insufficient force to carry the spray back into the propeller region.

The depression beneath the left wing becomes deeper as roll angle is increased since the effective height of this wing is reduced (Figures 4-57 and 4-58). Rolling the model raises the right wing; therefore, the depression for the left wing is deep than for the right as shown in Figures 4-59 and 4-60. A topographic of the water contours beneath the model at each roll condition is pre d in Figure 4-61.

4.3.3.8 Vertical Floats

Vertical floats (Figure 4.5) combined with a VTOL cap bility present great promise for a practical seaplane having an open ocean operational capability. The vertical floats provide a more stable platform at sea than does a flying boat configuration. T ats were mounted on the model approximately where the heavy sp ay f ns originate from the fore and aft ends of the depression. Thus, the floats served as spray deflectors, reducing spray circulation for the majority of the cases shown in Figures 4-62 and 4-63. The floats also block the slipstream and force the water depression to become deeper, according to Figures 4-64 and 4-65.

4.3.4 Droplet Size Investigation

The size of droplets entrained in an airstream determines the droplet trajectory. Previous investigators (References 4-3 and 4-4) have indicated that the droplets created by small-scale devices are actually larger

than their full-scale counterparts when a scaled disc loading is used. Reference 4-7 used a shock tube with a velocity peak to determine the maximum droplet size that can exist in a flow field with a given velocity. The largest droplets photographed during this test compare favorably (Figure 4-66) with results from Reference 4-7 when the maximum velocity across the water is used. The same trend is evident from Figures 4-67 and 4-68, since more of the droplets are in the larger size ranges for the lower disc loading. The introduction of wind apparently changes this trend (Figures 4-69 and 4-70). The preceding samples were obtained about 10 feet aft, 8 feet to the left of model erline, and approximately 1 foot above the water surface. The sample shown in Figure 4-71 was taken aft of the model beside the tank approximately 4 feet below water level and 12 feet to the left of the model. A typical mic otograph of a droplet snatcher slide is shown in Figure 4-72.

Photographs through a 40-inch lens system were taken of the area near depth gage No. 28. The depth of field was very shallow; thus droplets that are in focus are in the same plane as the depth gage, which provides a method of scaling. A typical photograph is presented in Figure 4-73. Only a small amount of data was successfully recorded with this method; consequently, the data from all three disc loadings were combined and are presented in Figure 4-74. These data also indicate that most of the droplets are below 100 microns in diameter. However, since the 6.45 disc loading was included and the droplets were not subject to shattering, more droplets in the larger size bands were detected.

4.3.5 Effects of a Non-Newtonian Fluid

Approximately two pounds of polyethylene oxide (poly-ox) were sprinkled on the water beneath the model. This compound has a molecular weight of approximately six million and forms a heavy gelatinlike coating on

water. This coating slowly dissolved as the poly-ox increased the surface tension of the water, causing noticeably larger droplets to be formed at the same test condition. These larger droplets had a tendency to precipitate, giving an overall reduction in spray.

After the poly-ox was spread, it was discovered that a foreign object had been dropped on the left side. Retrieving this object disturbed the poly-ox coating, causing the coating to sink a few inches below the surface of the water. This, perhaps, explains the deep depression with poly-ox shown in Figures 4-75 and 4-76.

Application of the poly-ox was rendered difficult by a slight breeze wafting the light powder away. Larger grain size would ease application but would probably increase the time required for the pad to dissolve. A more buoyant form would also be advantageous. A number of similar compounds are available, and tests of each might lead to the discovery of a spray inhibitor in a most useful form.

4.4 DATA SCALING

Considerations of dynamic similarity between fluid motions on the model scale and full scale are extremely important in acquiring representative and meaningful results in any experiment. For the present problem, the forces which appear to predominate are inertial, gravitational, viscous, and surface tension (Reference 4-2). Dividing the last three by the inertial force yields the Froude, Reynolds, and Weber numbers, respectively. These three ratios cannot be satisfied simultaneously; consequently, complete dynamic similarity is not possible. The ratio having the strongest influence must be satisfied, realizing that other effects may be distorted.

If viscous and surface tension effects are ignored, the resulting flow, including the cavity shape and air velocity field, depends only upon the Froude number which is defined by:

$$Fr = q_n/gD$$

Where:

q_n = Disc loading of the propulsive unit

g = Gravitational constant

D = Diameter of propulsive unit

The spray cloud height was used in Reference 4-4 as a criterion to make the following modification to the Froude number:

$$F_{CW} = \frac{q_n - q_o}{gD}$$

Where q_o is the dynamic pressure across the water required to initiate spray (approximately 2 psf). The full-scale disc loadings presented in Table 4-2 were derived from this relationship. Comparisons of motion pictures of the model and the XC-142A actual airplane under similar conditions indicate that the wave patterns and heavy spray characteristics are better represented by a model disc loading approximately 50% higher than that derived from the relationship used in Reference 4-4. This agrees with the conclusions reached in Reference 4-8.

The effect of viscosity, or Reynolds number, would be expected to affect two areas: mixing at the jet boundary and shear at the air/water interface. The effects of mixing at the jet boundary are currently undefined.although they are believed to be small.

No only viscosity but also surface tension, or Weber number, plays a significant role in spray formation at the air/water interface. This

portion of the flow was studied using comparisons of full-scale and model motion pictures. The pictures indicated that more light spray was present for the XC-142A airplane than for the model tests. This is directly attributable to the inability to scale Weber number.

Increasing Froude, Reynolds, and Weber numbers increased the spray recirculation for a given test condition as shown in Figures 4-77 to 4-89. Since each of these parameters is directly proportional to disc loading, the result was to be expected.

4.5 SIGNIFICANCE OF RESULTS

The results of this test have been compared with other tests to improve the applicability of the data. Comparisons for each type of downwash environment measurement are presented in the following sections.

4.5.1 <u>Spray Circulation</u>

The majority of the spray circulation measurements recorded in the literature have been concerned with salt ingestion by gas turbine helicopter engines. The salt ingestion rate for helicopters hovering in zero wind conditions generally falls below 1 ppm salt-in-air (Reference 4-1). Limited data for the P6M and XF2Y while waterborne indicates that aircraft ingested 2,000 to 4,000 ppm salt-in-air in some conditions. The amount of water trapped in the moisture meters was scaled to a full-scale XC-142A by assuming that the same quantity of water would pass through a given flow area in a unit time. The results, presented in Table 4-1, indicate that salt ingestion for the XC-142A will be slightly greater than for a helicopter at the same conditions.

4.5.2 <u>Depression Shape</u>

Another report in the area of depression depth and shape is Reference 4-9, which presents a wealth of test data for isolated uniform jets

of various sizes over water. Various depression parameters were carefully measured and correlations were prepared. Although the present test used overlapping propellers which created a vortex-filled slipstream with a fountain effect beneath the fuselage, the data from this test correlates well with the data from Reference 4-9, as shown in Figures 4-80 and 4-81.

The discrepancies in depression depth shown in Figure 4-80 are apparently the result of model height effects as shown by the points at low heights ($H/D < 12$) presented by Reference 4-9. Figure 4-81 shows that the depression diameter (measured fore and aft for this test) agrees very well with Reference 4-9.

An alternate method of predicting depression depth was also considered. The maximum dynamic pressure moving across the ground as a function of propeller height was obtained from Reference 4-3 and presented in Figure 4-82. These data were used to determine the maximum dynamic pressure over the water for this test. This term gave an excellent correlation with depression depth for the present test at various conditions as shown in Figure 4-83.

To predict the depth and diameter of the depression beneath the full-scale XC-142, two methods have been employed. A typical movie frame from the model data was increased ninefold to represent a full-scale depression. Predictions of the depression depth and diameter of the depression were prepared for the same conditions using Figures 4-81 and 4-83. The predicted contours for the full-scale XC-142 and the predicted depth and diameter of the depression are compared in Figures 4-84 to 4-86. The results show good agreement when the time variation of the contour is considered; apparently either method can be used to predict full-scale depression characteristics.

4.5.3 Droplet Size

From Figures 4-67 through 4-71 it can be seen that the majority of the droplets recorded during this test fell between 0 and 100 microns. This agrees very well with similar data for a helicopter (Reference 4-10), which hovered at a disc loading of approximately 6.2 psf. The maximum droplet size recorded beneath the helicopter compares well with this test and Reference 4-7 as shown in Figure 4-66. Additional testing would be required to determine if the droplets in spray from a full-scale airplane are appreciably smaller than the model droplets.

4.5.4 General Spray Patterns

From motion pictures and visual observations it was found that the most notable spray pattern characteristic of the full-scale XC-142A hovering over water was the spray donut formed in the flow field by the rollup of the airflow. The outside of this pattern is nearly vertical and the inside is sloping,which give the spray the appearance of a football stadium. Although the tank was too small to reproduce this pattern, a similar pattern was formed in front of the model when the wind generator was operating.

Examination of motion pictures of the model test and full-scale test of the XC-142A and the XV-5A hovering over water revealed that spray is generated as the wavelets in the depression reach the lip of the depression and break. The frequency of this spray generation is apparently related to the size of the depression made by the aircraft slipstream since the frequency for the XC-142 model was about 4 per second, the XV-5A was about 1.8 per second,and the full-scale XC-142A was about 1.1 per second. These frequencies were obtained with each vehicle at about the same height-to-diameter ratio.

*Wave Length-To-Height Ratio of These Waves is 10:1. Wave Length-To-Height Ratio of All Other Waves is 15:1.

Tank Side Wall Height Inches	Roll Angle	Wing Angle	FLOATS	$H/_D$	WIND	Wave Height Inches	Disc Loading PSF	Ambient Winds Direction/ Knots	Model Water Flo		
									Left Hand Meters		
									1	2	3
0	0	90	OFF	3.7	OFF	0	10.82	-/0	-	.00002624	0
				3.7			15.25	-/0	.00002624	.00003936	.00001312
				2.5			10.82	-/0	.0000591	.00001968	.0000459
				2.5			15.25	-/0	.00001312	.0001246	.0000786
				1.6			10.82	-/0	.000321	.000459	.000236
				1.6			15.25	-/0	.000505	.001265	-
				1.4			6.45	-/0	-	.000328	0
				1.4			10.82	-/0	.0000787	.000164	.0000985
				1.4			15.25	-/0	-	.00151	-
7		70		3.7	ON		15.25	-/0	0	0	.000214
7		75					15.25	-/0	.000623	.000492	.000603
7		80					15.25	-/0	.000643	.000616	.000905
7		85					15.25	-/0	.00059	.000721	.000918
7		90			OFF	0	10.82	N/5	.0001115	.000164	.0001246
6						0	10.82	S/10-20	.00001312	.0000984	.0001836
6						0	15.25	S/10-20	.000736	.000413	.00082
7						0	15.25	N/5	.00177	.00179	.00095
6						6*	10.82	NW/5	0	0	0
6						6*	15.25	NW/5	.0000524	.000348	.000295
6						6	15.25	N/4-10	-	.000695	-
6						12	10.82	NW/6-10	0	0	.00001965
6						12	15.25	NW/6-10	.0001835	.000105	.000216
6					ON	0	10.82	S/10-20	.00001312	.00000656	.00000656
6						0	15.25	S/10-20	.000774	.000478	.000492
6						6*	10.82	N/4-10	.000439	.000557	.000511
6						6	10.82	N/4-10	0	0	-
6						6*	15.25	N/4-10	.001462	.000531	.001036
7						8	10.82	NE/6	.0059	.000144	.00008528
7				2.5	OFF	0	6.45	S/12	0	.0000328	0
7						0	10.82	-/0	0	0	0
7						0	10.82	S/3	0	.0001181	.0001508
7						0	10.82	S/3	0	.00001968	.000151
7						0	10.82	S/3	.0000656	.0000394	.0000918
7						0	15.25	-/0	.000459	.001212	.001112
7						6	6.45	S/8	-	-	-
7						6	10.82	S/10-18	.001148	.00105	.000853
7						6	15.25	S/10-18	.0001574	.0002886	.000633
7						12	10.82	S/2	.0003477	.0009643	.0010889
7						12	15.25	S/2	.0004395	.0004395	.0006035
7					ON	0	6.45	S/10	0	-	0
7						0	10.82	E/4	.00426	.000328	.000295
7						0	15.25	E/4	.001135	.00528	.00523

A

TURE METER DATA

	low Rate $\sim \frac{LB}{IN^2}$ - MIN					Average Model Water Flow Rate~lb/In^2-Min	Average Full Scale Water Flow Rate~lb/-Min	Average Full Scale Dry Salt-In Air Content ~ PPM	Run Number	Point
		Right Hand Meters								
	4	1	2	3	4					
	.00001312	.00001312	.00002624	.0000328	.00002624	.0000197	.003845	.08192	1	2
12	.00004592	.0000328	.00002624	.00003936	.00005248	.000034	.00663	.14144	1	3
9	.00002624	.00002624	.0000853	.00003936	.000059	.000045	.00878	.18656	2	2
5	.000236	.0000656	.000419	.0004	.0001968	.0001916	.0374	.7968	2	3
	.000354	.000059	.000249	.000177	.000315	.000027125	.00529	.1129	3	2
	.001153	.00059	.00193	.0014	.00644	.000018261	.00356	.07584	3	3
	.0000131	0	0	0	0	.0000656	.00128	.02736	4	1
5	.000269	-	.0000131	0	0	.000089	.0177	.3776	4	2
	.00253	.0000262	.000151	.0008	.000675	.001351	.264	5.632	4	3
	0	.000164	0	.000164	.0000656	.000076	.0148	.31552	15	3
	.000492	.000689	.000249	.000538	.000656	.00005428	.0106	.17856	14	3
	.000787	.000853	-	.000414	.00111	.00007611	.01483	.31552	13	3
	.00118	.00105	.000426	.000689	.000669	.00007804	.01521	.3248	12	3
5	.000328	.000275	.000538	.000288	.0005[illegible]	.00030238	.059	1.2576	24	2
5	.00000656	0	0	0	0	.0000376	.00734	.15616	5	2
	.000295	.000518	.000643	.0012136	.001758	.0007375	.1439	3.0528	5	3
	.00210	.001377	.00272	.002145	.003096	.00001994	.003894	.08288	24	3
	0	0	0	0	0	0	0	0	7	2
	.000242	.0001248	.000774	-	.000426	.0003231	.063	1.344	7	3
	-	-	.0001968	.000328	.000446	.0004164	.0813	1.728	8	3
55	.0000393	0	0	0	.0000656	0	0	0	10	2
	.000557	.00017	.000164	.0000656	.0001965	.0002072	.04045	.8628	10	3
56	.00001312	0	0	.00001312	.00001968	.00000901	.001759	.03744	6	3
	.000524	.003011	.00023	.000328	.000512	.0007935	.15485	3.[illegible]92	6	[illegible]
	.000629	.000059	.00019	.000242	-	.000375	.0731	1.5552	9	2
	0	-	0	0	0	0	0	0	11	2
	.00176	.000905	.000721	.000754	.000557	.0009657	.1881	[illegible]	9	3
28	.000262	.0002296	.000164	.000374	.0001968	.00025571	.0498	1.0622	25	2
	-	-	0	-	-	.0000082	.0016	.034128	36	1
	0	.0001115	0	.0000328	0	.00007215	.01405	.29989	18	2
)	.00021	.0000722	.0002428	.000341	.00059	.0002464	.0481	1.026	46	2
	.000728	.000433	.000886	0	.0004265	.0004407	.086	1.8344	47	2
)	.000164	.0000394	.000151	.000151	.000223	.0001157	[illegible]	.4809	48	2
	.0017	.00177	.00326	.00116	.000446	.001389	.271	5.78	18	3
	-	-	-	0	-	0	0	0	34	1
	.00105	.000754	.000787	.000328	.000964	.00086675	.169	3.605	34	2
	.0007216	.000354	-	.001207	.001102	.0037474	.73067	15.592	34	3
	.0012136	.0024731	.0036146	.0029979	.004428	.002141	.417295	8.9053	45	2
	.0005116	.0002755	.0012792	.0009708	.0002427	.000598	.11661	2.4871	45	3
	.0000328	.0000328	0	.0000328	0	.0000141	.0027495	.05868	37	1
	.000721	.000446	.0000656	.0000984	.000459	.0008341	.1616495	3.438	19	2
	.00567	.0057	.00344	.00381	[illegible]	.0043156	[illegible]	[illegible]	19	3

B

4.5.3 Droplet Size

From Figures 4-67 through 4-71 it can be seen that the majority of the droplets recorded during this test fell between 0 and 100 microns. This agrees very well with similar data for a helicopter (Reference 4-10), which hovered at a disc loading of approximately 6.2 psf. The maximum droplet size recorded beneath the helicopter compares well with this test and Reference 4-7 as shown in Figure 4-66. Additional testing would be required to determine if the droplets in spray from a full-scale airplane are appreciably smaller than the model droplets.

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TABLE 4-1 MOISTURE METER

Tank Side Wall Height Inches	Roll Angle	Wing Angle	FLOATS	H/D	WIND	Wave Height Inches	Disc Loading PSF	Ambient Winds Direction/ Knots	Model Water Flow Rate ~ Left Hand Meters 1	2	3	4
7	0	90	OFF	2.5	ON	6	6.45	S/16	.0000984	-	.0000328	0
7						6	10.82	S/16	.001575	.001056	.000734	.00201
7						6	15.25	S/16	.00894	.010489	.00998	.0097
7						12	6.45	S/2	.0024731	-	-	.0000
7						12	10.82	S/2	.0015088	.0012464	.0007544	.0020
7						12	15.25	S/2	.0035096	.0104763	.0131266	.00801
7				2.0	OFF	0	10.82	-/0	.0001968	.0000984	.0001968	.0000
7						0	15.25	-/0	.0013776	.00282	.00249	.00492
7						6	10.82	S/8-12	.0003936	.0000656	.0002624	.0001
7						6	15.25	S/6-8	.01647	.01685	.01870	.01935
7						12	6.45	S/8	.0000656	.00001968	.0000328	.00007
7						12	10.82	S/8	.0004854	.001167	-	.00116
7					ON	0	10.82	S/5	.00236	.0019024	.00164	.00242
7						0	15.25	S/5	.019	.01508	.0123	.0117
7						6	10.82	SE/4	.00879	.01705	.00787	.011
7						6	15.25	-/0	-	.0132	.02047	.01863
7						12	6.45	S/8	.0000262	.0000459	.0000525	.0000
7						12	10.32	S/8	.010398	.009774	.00656	.01381
7				1.6	OFF	0	6.45	NE/7	-	-	-	-
7						0	10.82	NE/7	.0000656	-	-	-
7						6	6.45	-/0	.000243	.000413	.00061	.00074
7						6	10.82	-/0	.0028	.00085	.00514	.00829
7					ON	0	6.45	NE/6-8	0	.0000459	.0000656	.00001
7						0	10.82	NE/6-8	.00665	.007111	.006008	.00452
7						6	6.45	-/0	.0000459	.00005298	.0002165	.00015
7						6	10.82	-/0	-	.0148	.01338	.01725
7				1.4	OFF	0	6.45	-/0	-	.00001968	.00001968	.00001
7						0	10.82	-/0	-	.0001968	.000262	.00002
7						6	6.45	S/12	.000492	.000164	.000328	.00032
7						6	10.82	S/10	.00118	.004592	.00236	.00104
7					ON	0	6.45	-/0	.00807	.00758	.00538	.00587
7						0	10.82	-/0	.02538	.022	.01364	.02132
7						6	6.45	-/0	.00368	-	-	.0000
7						6	10.82	S/10	.00017056	.000105	-	.0000
7			ON	3.7	OFF	0	10.82	N/2	.0000656	.0000984	.00001968	-
7						0	15.25	N/2	.0002952	.0003936	.000328	.00036
7						6	6.45	SW/2	.0000328	.0000656	.0000328	.0000
7						6	10.82	SW/2	.0000328	.0000328	.0000656	0
7						6	15.25	SW/6	.0000328	.0000984	.0000328	.00013
7					ON	0	10.82	NW/3	.0000328	0	0	.0000
7						0	15.25	NW/3	.0011808	.0005248	.0004592	.00072
7						6	10.32	SW/6	.000131	.00131	.000656	.00065
7						6	15.25	SW/6	.001738	.0010168	-	.00124
7				2.5	OFF	0	10.82	NW/2	.0001312	.000328	.000328	.0004
7						0	15.25	NW/2	.000328	.000623	.000754	.00095

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ISTURE METER DATA (CONT)

low Rate ~ LB/IN² - MIN						Average Model Water Flow Rate~lb/In² min	Average Full Scale Water Flow Rate lb/-Min	Average Full Scale Dry Salt-In Air Content PPM	Run Number	Point
		Right Hand Meters								
3	4	1	2	3	4					
00328	0	.0000328	.0000656	-	.0000328	.0000437	.008547	.1835	35	1
0734	.002015	.00666	.003482	.0036	.00755	.003335	.65033	13.8715	35	2
998	.009702	.010332	.0090396	.010732	.010312	.0199	3.8805	82.7711	35	3
-	.00000656	.00001968	.0000328	.0000656	-	.000507	.098865	2.11	44	1
07544	.0020992	.0030832	.001148	.0006888	.0030837	.001701	.3317	7.07	44	2
31266	.0080163	.0101024	.0032013	.0097613	.0110405	.008654	1.68753	35.9	44	3
01968	.0000656	.00082	.0001968	.0001968	.0000459	.0001968	.038376	.819	20	2
249	.00492	-	-	-	-	.0029	.5655	12.08	20	3
02624	.000131	.0003936	.00131	.001115	.00109	.00059515	.116025	2.479	22	2
870	.01935	.00249	.004067	.004067	.000118	.01081667	2.0099	42.7	22	3
00328	.00007216	.00004592	.00001968	.0001049	.0001443	.0000558	.010881	.232	49	1
-	.001167	.001469	.0031291	.00244	.0020795	.001705	.3325	7.09	49	2
164	.002427	.00787	.001246	.01213	.00262	.0040244	.78476	16.81	21	2
23	.0117	.01541	.009708	.009774	.00332	.0120365	2.3471175	50.	21	3
787	.011	.0042	.00223	.001837	.010758	.0079669	1.62033	34.4	23	2
047	.01863	.0198	.0097	.01574	.01338	.0158457	3.08977	65.9	23	3
00525	.00000656	.0000918	.0000328	0	-	.0000426	.008307	.178	50	1
656	.01381531	.009807	.006724	.010004	.0089216	.009426	1.83807	39.18	50	2
-	-	-	.000164	-	-	.000164	.03198	.682	26	1
-	-	.0001968	.0000262	.0000656	.000262	.0001232	.024034	.512	26	2
061	.000741	.000131	.0004526	.0000328	.0000656	.0003361	.0653395	1.39	28	1
514	.008298	.0021189	.000774	.0013317	.0009184	.0027751	.5401445	11.53	28	2
00656	.00001968	.00001968	.0002296	0	0	.00004756	.0092732	.1975	27	1
6008	.004526	.005471	.00316	.00236	.004526	.0049765	.9694175	20.62	27	2
02165	.000151	.007183	.0000918	.000984	.00421	.0016168	.315315	6.725	29	1
338	.017253	.00935	.02326	.00909	.01456	.0145275	2.83335	61.5	29	2
001968	.00001968	.000177	-	.000131	.00018368	.00009178	.017897	.3819	30	1
0262	.0000262	.00017	.00017	.001876	.001574	.0006107	.119087	2.54	30	2
0328	.000328	.000131	.0000328	.0000656	.0000131	.0001943	.03789	.807	33	1
236	.001049	.00059	.000892	.0001968	.0009184	.00147235	.28712	6.125	33	2
538	.00587	.00558	.00672	.0098	.00543	.0068	.1.326	28.25	32	1
364	.02132	.02289	.008	.00682	.01108	.0163925	3.198635	66.1	32	2
-	.0000656	.000656	.000262	.0001312	.0000656	.00081006	.0157962	.3362	31	1
-	.0000656	.0001312	.0000787	.000105	.00003936	.00009934	.019371	.4125	31	2
001968	-	.0001312	.0001312	.0000984	.0000656	.0002137	.031672	.675	40	2
0328	.0003608	.000656	.0008856	.0008528	.0014104	.0006478	.126331	2.69	40	3
00328	.0000656	0	0	0	.0000328	.0000287	.005597	.1172	38	1
00656	0	-	.0000328	.0000656	0	.0000287	.005597	.1172	38	2
00328	.000131	.000164	.000262	.000229	.0001968	.0001433	.027944	.596	38	3
0	.0000328	.0000656	-	.001148	.0000984	.0001722	.03358	.716	41	2
04592	.0007216	.0019024	.0005248	.0003936	.0006888	.0007995	.1559	3.325	41	3
0656	.000656	.000361	.00001312	.0001312	.0000656	.0002098	.040911	.872	39	2
-	.0012464	-	.0005248	.007872	.0013776	.0011513	.2244	4.79	39	3
0328	.0004265	.0001312	.0002295	.0005576	.0008525	.0003803	.0741585	1.58	42	2
0754	.0009512	.0003608	.0012792	.00164	.000246	.0011274	.225243	4.81	42	3

TABLE 4-1 MOISTURE ME

Tank Side Wall Height Inches	Roll Angle	Wing Angle	FLOATS	H/D	WIND	Weight Height Inches	Disc Loading PSF	Ambient Winds Direction/ Knots	Model Water Fl		
									Left Hand Meters		
									1	2	3
7	0	90	ON	2.5	ON	0	10.82	-/0	.0014104	.000984	.000656
7						0	15.25	-/0	.0030176	.0017712	.0019024
7	-5		OFF		OFF	0	6.45	VAR/2	.00002624	.00001968	.00001968
7						0	10.82	NE/4	.00001968	.00001312	.00000656
7						0	15.25	-/0	.00005248	.00007216	.0000656
7						6	10.82	-/0	.00009184	.00007216	.00005904
7						6	15.25	NE/5	.00046576	.00008528	.00007872
7						12	10.82	-/0	-.00017712	-.0002493	-.00024272
7						12	15.25	-/0	.00005904	.00012464	.0001312
7					ON	0	10.82	VAR./3-4	.0013185	.00064944	.00078064
7						0	15.25	NE/4	.0048806	.00033653	.0036605
7						6	10.82	N/4	.00067568	.0014694	.00056416
7						6	15.25	-/0	.0073013	.0066518	.005143
7						12	10.82	-/0	.0010496	.000328	.0004592
7						12	15.25	-/0	.0062387	.0049594	.0056744
7	-10			3.7	OFF	0	10.82	-/0	.00000656	.00001968	.00132512
7						6	10.82	N-NW/20-22	-.00002624	0	0
7						6	10.82	W/5	0	-.00001312	.00000656
7						6	15.25	W/5	.00000656	.00001312	.00001312
7					ON	0	10.82	NE/5	.00001312	.00000656	.00000656
7						6	10.82	S-SE/16	-.00001312	.00001968	-.00011152
7						6	15.25	S/15	.00064288	.00007872	.0011283
7				2.5	OFF	0	10.82	-/0	.00001312	.00001312	0
7						0	15.25	-/0	.00005904	.00005904	.00001968
7						6	10.82	NW/5	.00017056	.0001968	.00015088
7						6	15.25	N-NW/8	.0004789	.0007478	.00066912
7						12	10.82	N/10	-.00002624	.00001312	-.00003936
7						12	15.25	N/10	.0010561	.00150224	.00090528
7					ON	0	10.82	VAR/2	.00000656	.00046576	.00033456
7						0	15.25	VAR/2	.00414592	.00202046	.00280768
7						6	10.82	NE/10	.00070192	.0023813	.0004002
7						6	15.25	NW/8	.0046904	.00264368	.003608
7						12	10.82	NW/4	.00184992	.0004654	.00074128
7						12	15.25	NW/4	.00977584	.00608768	.00702576
7			ON	3.7	OFF	0	10.82	N/5	.00001968	.00001968	.00001968
7						0	15.25	N/5	.0000328	.00005904	.00002624
7						6	10.82	W-NW/4	-.00001312	.00060052	.00001312
7						6	15.25	N-NW/2	.00034768	.00012464	.00003936

A

w Rate ~ LB/IN² - MIN		Right Hand Meters				Average Model Water Flow Rate~lb/In² min	Average Full Scale Water Flow Rate lb/-Min	Average Full Scale Dry Salt-In Air Content PPM	Run Number	Point
	4	1	2	3	4					
328	0	.0000328	.0000656	-	.0000328	.0000437	.008547	.1835	35	1
34	.002015	.00666	.003482	.0036	.00755	.003335	.65033	13.8715	35	2
8	.009702	.010332	.0090396	.010732	.010312	.0199	3.8805	82.7711	35	3
	.00000656	.00001968	.0000328	.0000656	-	.000507	.098865	2.11	44	1
544	.0020992	.0030832	.001148	.0006888	.0030837	.001701	.3317	7.07	44	2
266	.0080163	.0101024	.0032013	.0097613	.0110405	.008654	1.68753	35.9	44	3
968	.0000656	.00082	.0001968	.0001968	.0000459	.0001968	.038376	.819	20	2
9	.00492	-	-	-	-	.0029	.5655	12.08	20	3
624	.000131	.0003936	.00131	.001115	.00109	.00059515	.116025	2.479	22	2
0	.01935	.00249	.004067	.004067	.000118	.01081667	2.0099	42.7	22	3
328	.00007216	.00004592	.00001968	.0001049	.0001443	.0000558	.010881	.232	49	1
	.001167	.001469	.0031291	.00244	.0020795	.001705	.3325	7.09	49	2
4	.002427	.00787	.001246	.01213	.00262	.0040244	.78476	16.81	21	2
	.0117	.01541	.009708	.009774	.00332	.0120365	2.3471175	50.	21	3
7	.011	.0042	.00223	.001837	.010758	.0079669	1.62033	34.4	23	2
7	.01863	.0198	.0097	.01574	.01338	.0158457	3.08977	65.9	23	3
525	.00000656	.0000918	.0000328	0	-	.0000426	.008307	.178	50	1
6	.01381531	.009807	.006724	.010004	.0069216	.009426	1.83807	39.18	50	2
	-	-	.000164	-	-	.000164	.03198	.6[illegible]	26	1
	-	.0001968	.0000262	.0000656	.000262	.0001232	.024034	.512	26	2
1	.000741	.000131	.0004526	.0000328	.0000656	.0003361	.0653395	1.39	28	1
4	.008298	.0021189	.000774	.0013317	.0009184	.0027751	.5401445	11.53	28	2
556	.00001968	.00001968	.0002296	0	0	.00004756	.0092732	.1975	27	1
08	.004526	.005471	.00316	.00236	.004526	.0049765	.9694175	20.62	27	2
165	.000151	.007183	.0000918	.000984	.00421	.0016168	.315315	6.725	29	1
8	.017253	.00935	.02326	.00909	.01456	.0145275	2.83335	61.5	29	2
1968	.00001968	.000177	-	.000131	.00018368	.00009178	.017897	.3819	30	1
52	.0000262	.00017	.00017	.001876	.001574	.0006107	.119087	2.54	30	2
28	.000328	.000131	.0000328	.0000656	.0000131	.0001943	.03789	.807	33	1
6	.001049	.00059	.000892	.0001968	.0009184	.00147235	.28712	6.125	33	2
8	.00587	.00558	.00672	.0098	.00543	.0068	.1.326	28.25	32	1
4	.02132	.02289	.008	.00682	.01108	.0163925	3.198635	66.1	32	2
	.0000656	.000656	.000262	.0001312	.0000656	.00081006	.0157962	.3362	31	1
	.0000656	.0001312	.0000767	.000105	.00003936	.00009934	.019371	.4125	31	2
1968	-	.0001312	.0001312	.0000984	.0000656	.0002137	.031672	.675	40	2
28	.0003608	.000656	.0008856	.0008528	.0014104	.0006478	.126331	2.69	40	3
328	.0000656	0	0	0	.0000328	.0000287	.005597	.1172	38	1
656	0	-	.0000328	.0000656	0	.0000287	.005597	.1172	38	2
328	.000131	.000164	.000262	.000229	.0001968	.0001433	.027944	.596	38	3
	.0000328	.0000656	-	.001148	.0000984	.0001722	.03358	.716	41	2
592	.0007216	.0019024	.0005248	.0003936	.0006888	.0007995	.1559	3.325	41	3
56	.000656	.000361	.00001312	.0001312	.0000656	.0002098	.040911	.872	39	2
	.0012464	-	.0005248	.007872	.0013776	.0011513	.2244	4.79	39	3
28	.0004265	.0001312	.0002295	.0005576	.0008525	.0003803	.0741585	1.58	42	2
54	.0009512	.0003608	.0012792	.00164	.000246	.0011274	.225243	4.81	42	3

B

TABLE 4-2 MODEL TO FULL-SCALE CONVERSIONS

Disc Loading			
Full-Scale Disc Loading	Model Disc Loading	Full-Scale Gross Weight	Full-Scale Wind Speed[1]
42.5 lb/ft^2	6.45 lb/ft^2	32,000 lb	34 knots
82.4 lb/ft^2	10.82 lb/ft^2	62,000 lb	36.8 knots
125.3 lb/ft^2	15.25 lb/ft^2	94,000 lb	38 knots

Scale Conversions for a Full-Scale Aircraft with 15.6-Foot Diameter Propeller

Vehicle Height[2]			Wave Height	
H/D	Model Height	Full-Scale Height	Model	Full Scale
1.4	2.39 ft	21.9 ft	6 inch	4.5 ft
2.0	3.41 ft	31.25 ft	12 inch	9 ft
2.5	4.26 ft	39.05 ft		
3.7	6.31 ft	57.81 ft		

1 $q_{WIND_{FULL\ SCALE}} = q_{WIND_{MODEL}} \left(\dfrac{\text{Full-Scale Disc Loading}}{\text{Model Disc Loading}} \right)$

2 Measured from water surface to plane of outboard propellers

Table 4-3 Sea Conditions, U. S. Hydrographic Office Scale

* Wind Velocity is not included in the official definition of sea states
** Description of sea noise has been omitted

Sea State No.	Approx. Height of Sea Ft	Wind Velocity* Range Kts	Seaman's Description **
0	0	0	Calm - Sea like mirror
1	Less than 1	0 - 3	Smooth - Small wavelets or ripples with the appearance of scales but without crests
2	1 - 3	3 - 6	Slight - The waves or small rollers are short and more pronounced, when capping the foam is not white but more of a glossy appearance
3	3 - 5	6 - 10	Moderate - The waves or large rollers become longer and begin to show whitecaps occasionally
4	5 - 8	10 - 28	Rough - Medium waves that take a more pronounced long form with extensive whitecapping and white foam crests
5	8 - 12	28 - 40	Very rough - The medium waves become larger and begin to heap up, the whitecapping is continuous, and the seas break occasionally; the foam from the capping and breaking waves begins to be blown along in the direction of the wind.
6	12 - 20	40 - 50	High - Heavy, whitecapped waves that show a visible increase in height and are breaking extensively. The foam is blown in dense streaks along in the direction of the wind.

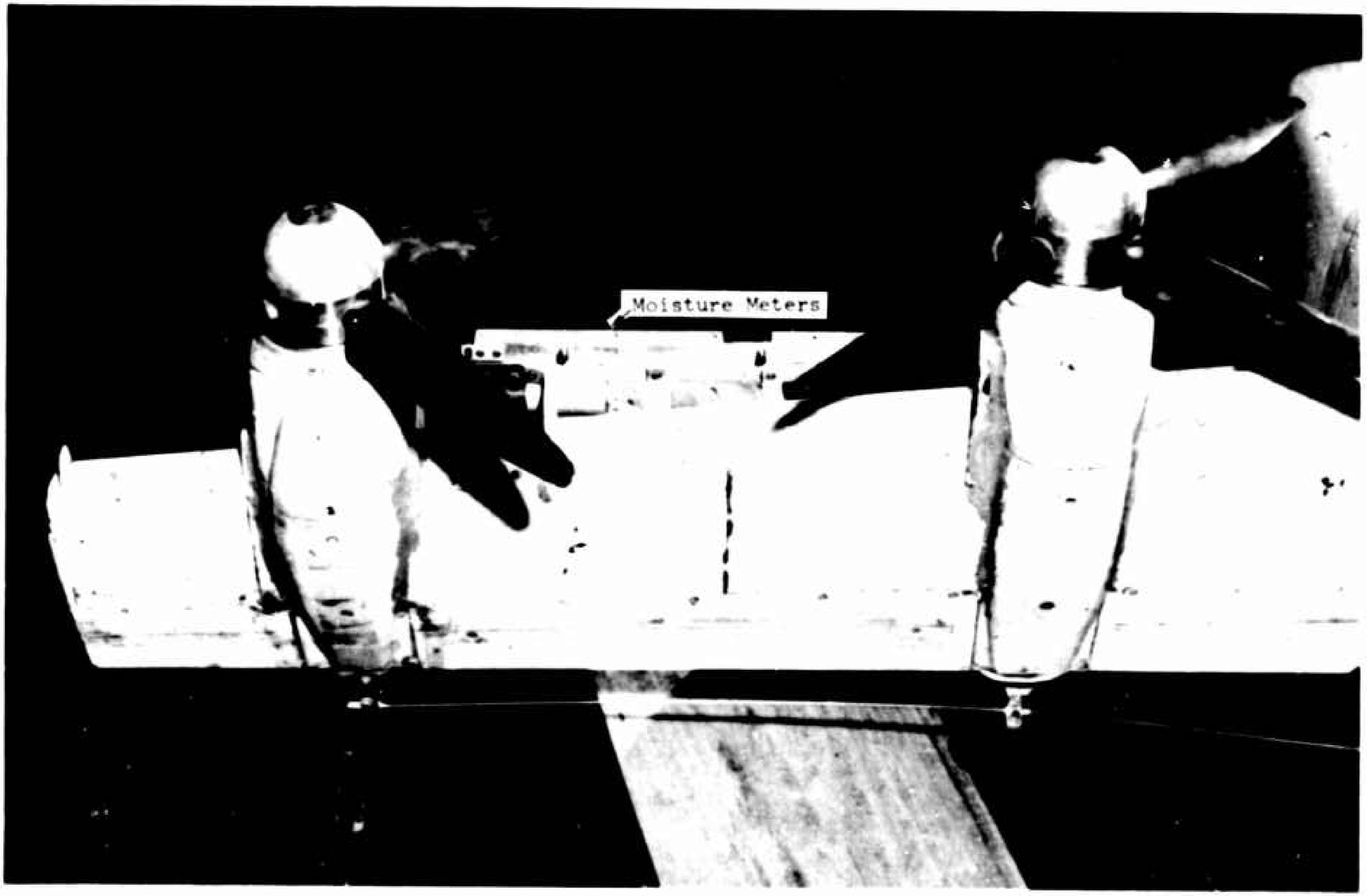


Figure 4-1 Moisture Meter Installation

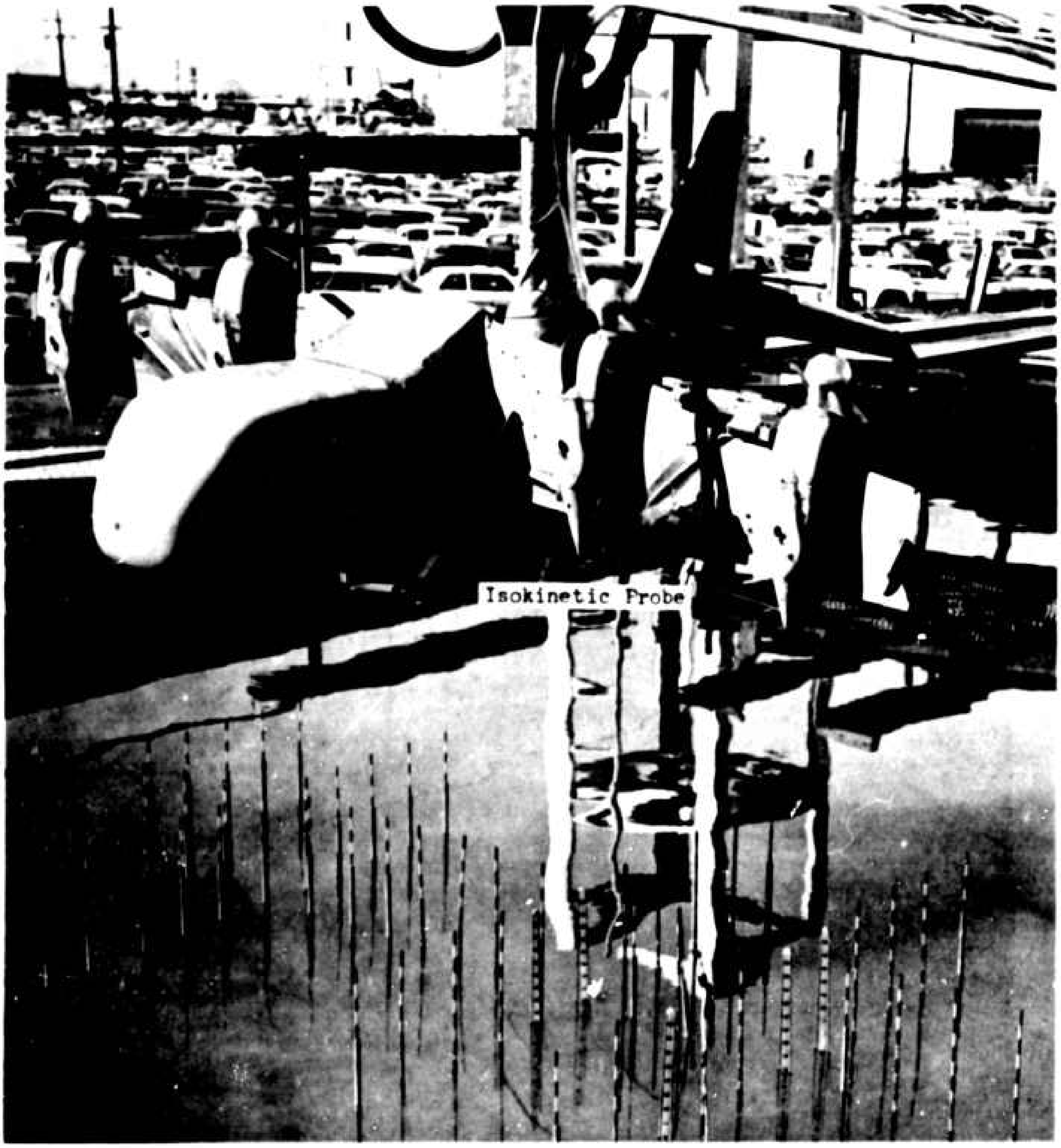


Figure 4-2 Isokinetic Probe Installation

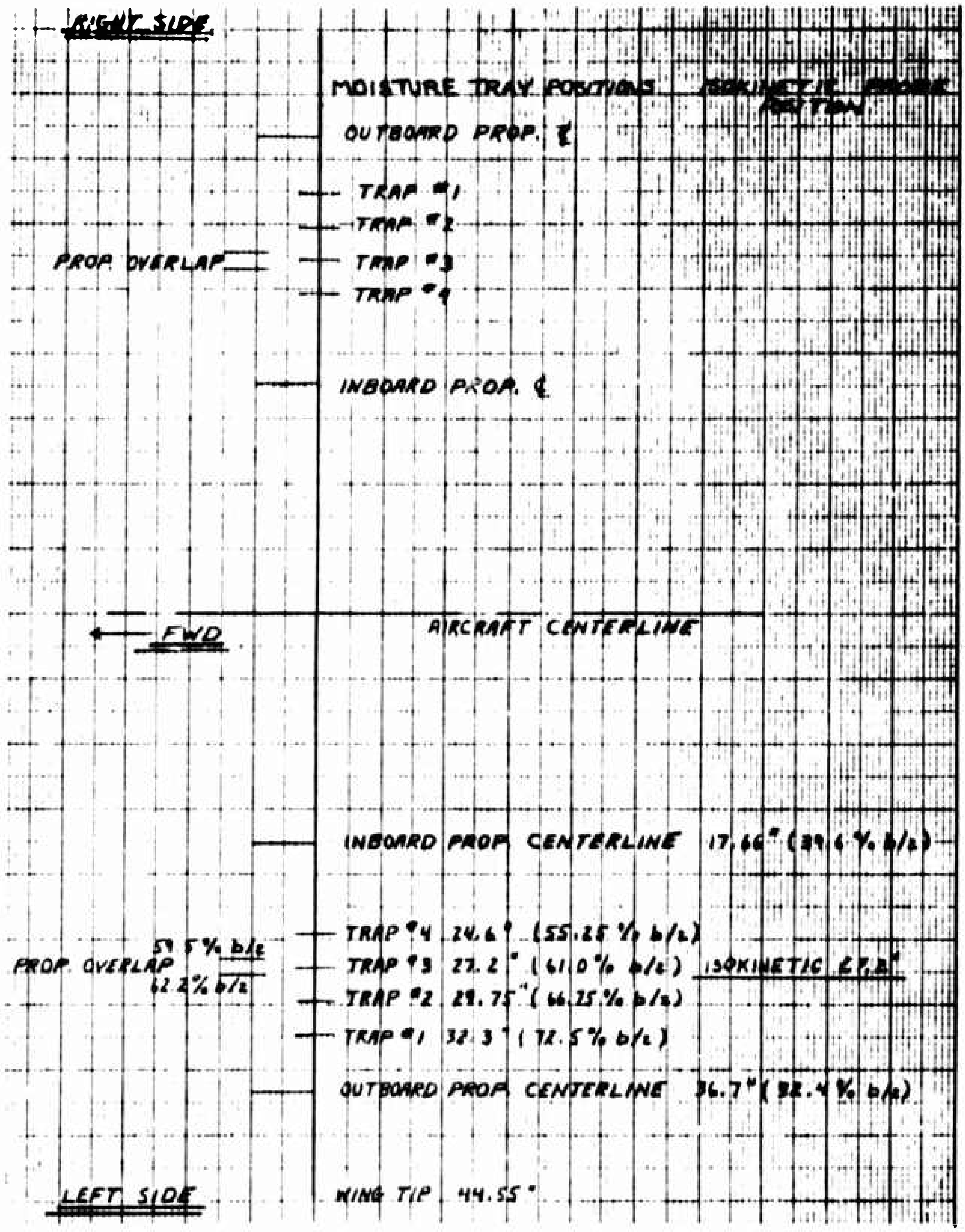


Figure 4-3 Positions of Moisture Meters and the Isokinetic Probe

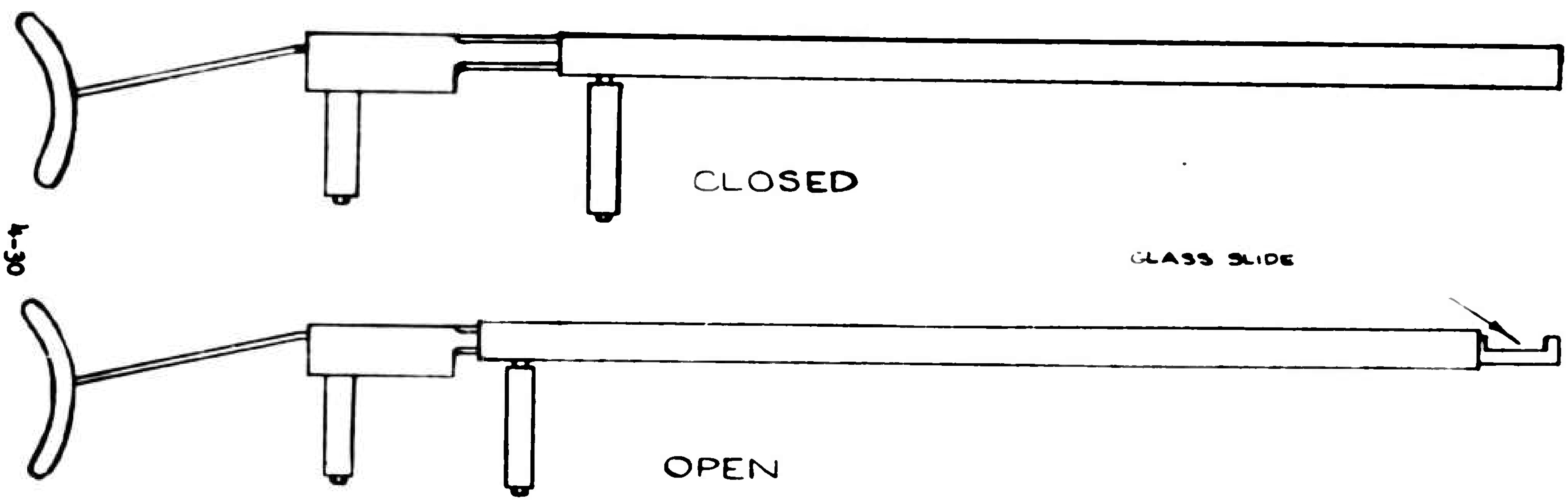


Figure 4-4 Droplet Snatcher

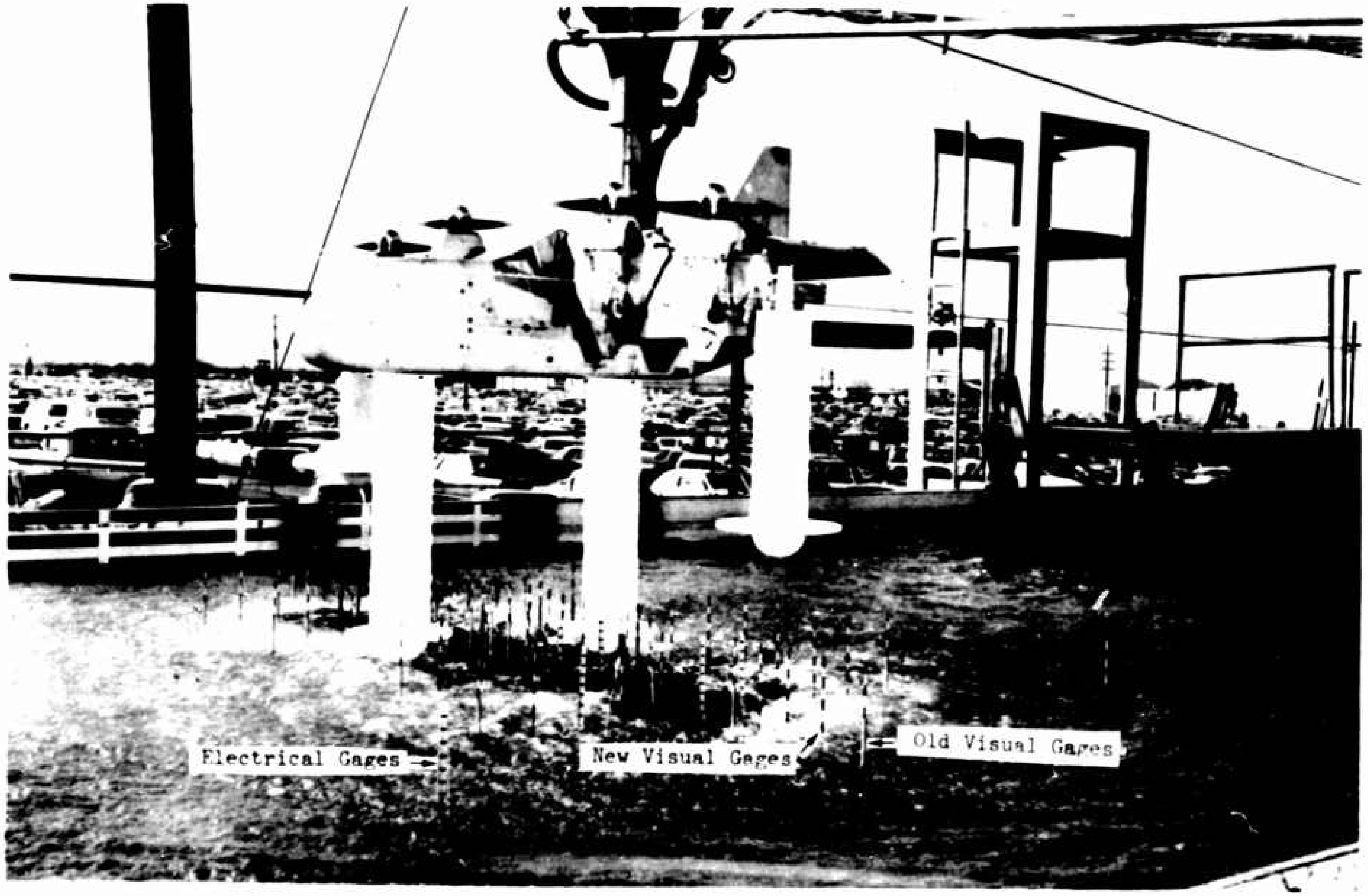


Figure 4-5 Depth Gage Installation and Vertical Float Configuration

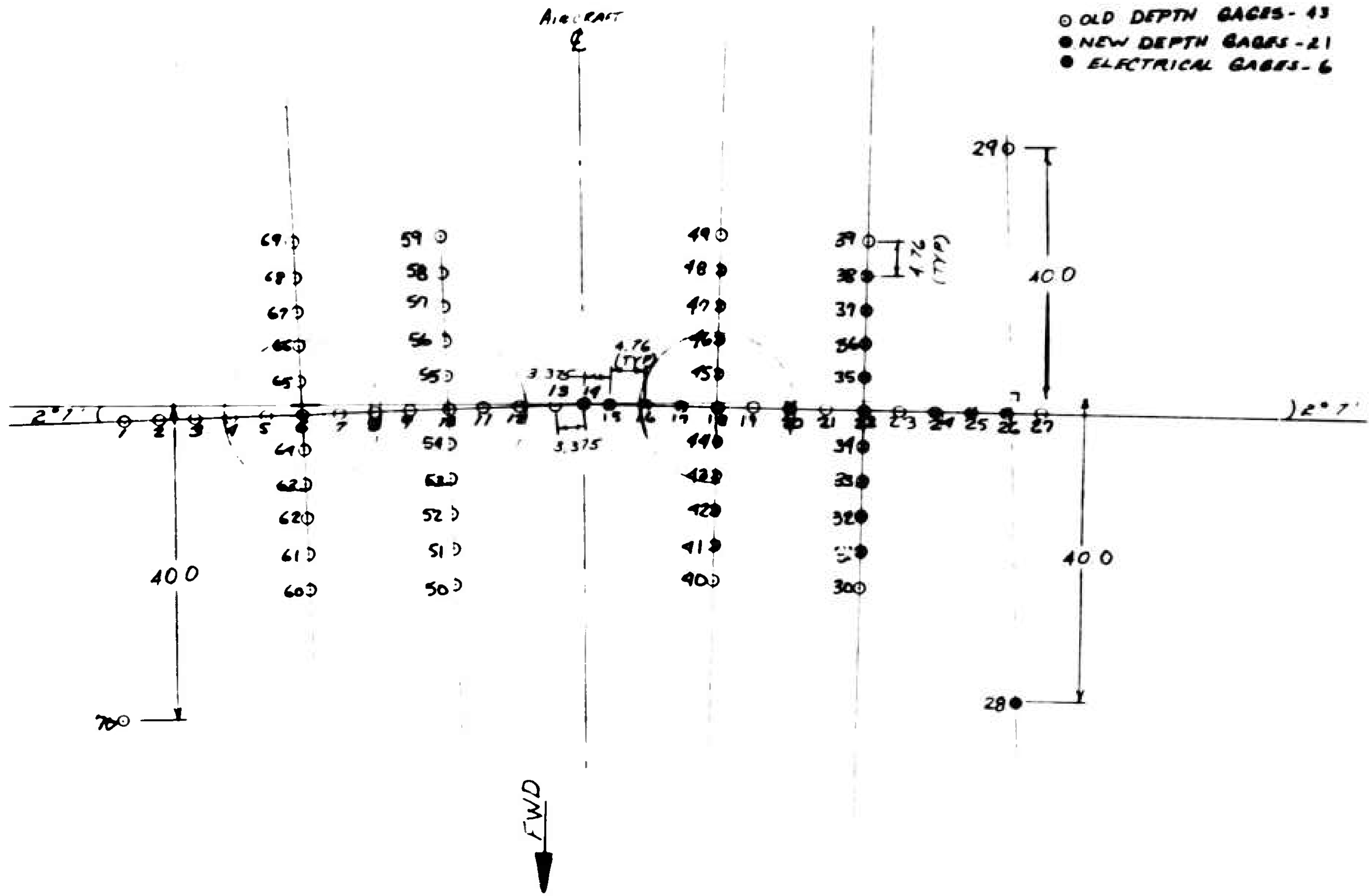


Figure 4-6 Depth Gage Pattern

Figure 4-7 Depression Beneath Model

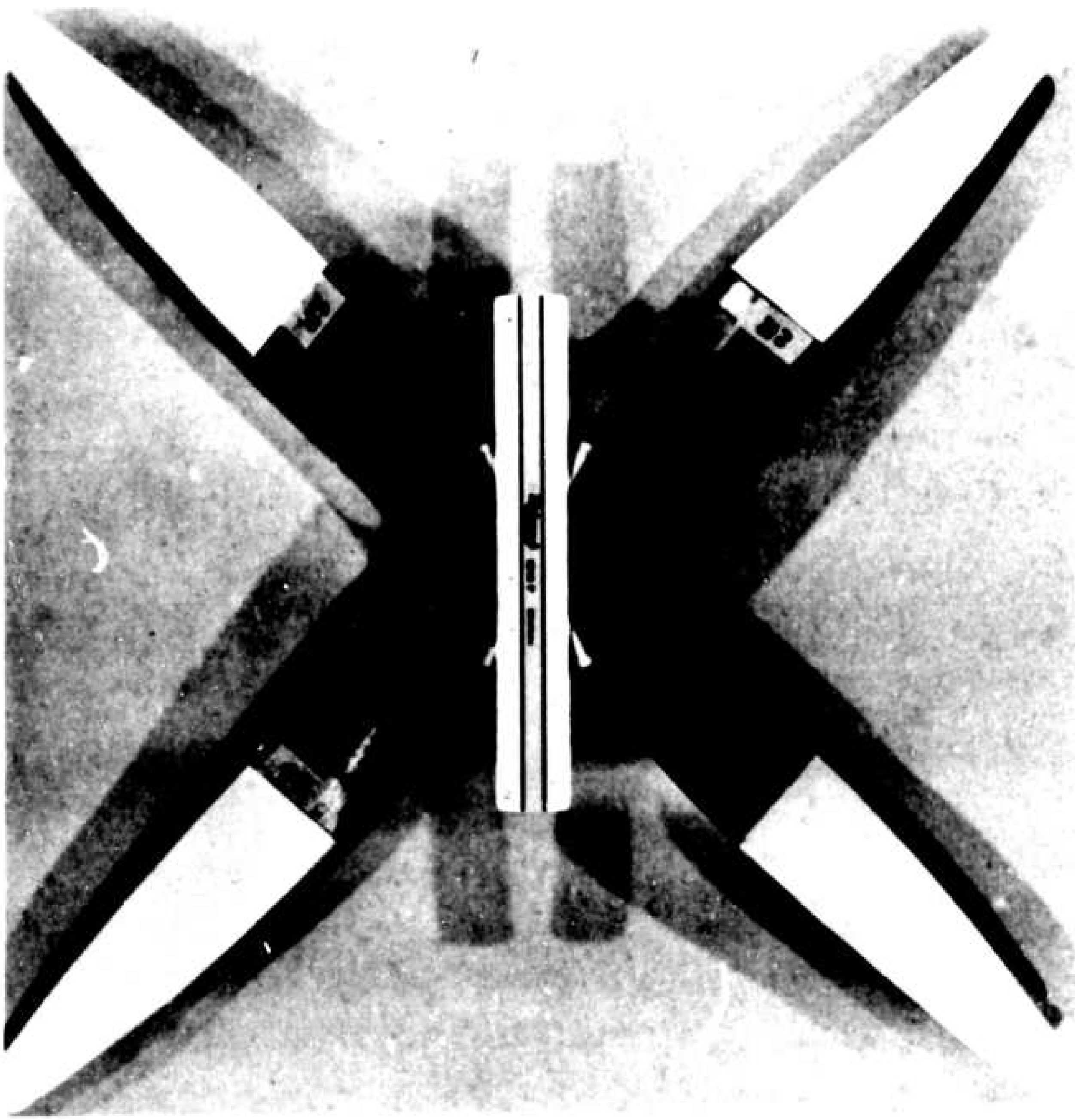


Figure 4-8 Neoprene Coated Propeller Prior to Installation

Figure 4-9 Uncoated Propeller after 21 Hours of Testing

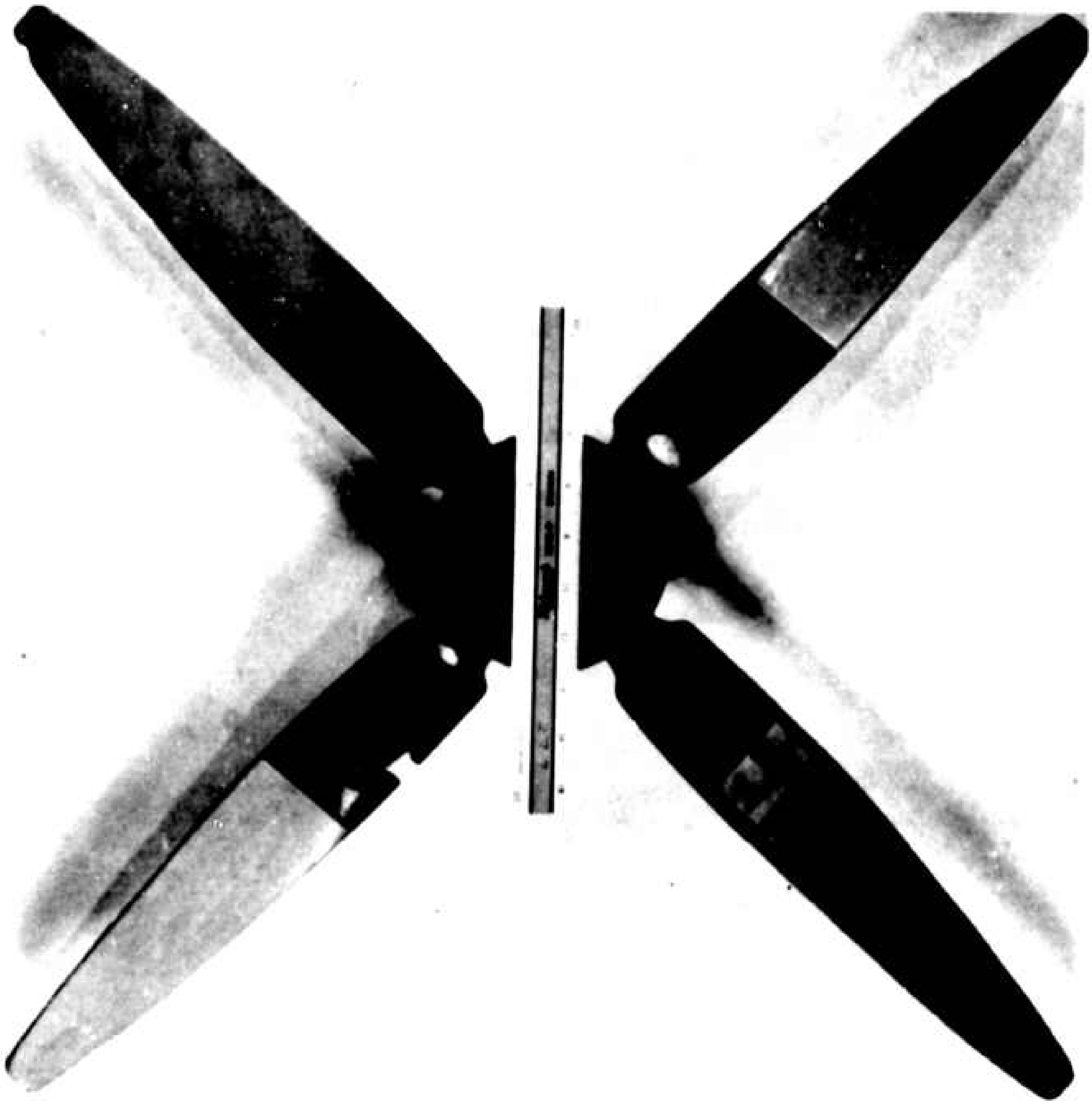


Figure 4-10 Coated Propeller after 21 Hours of Testing

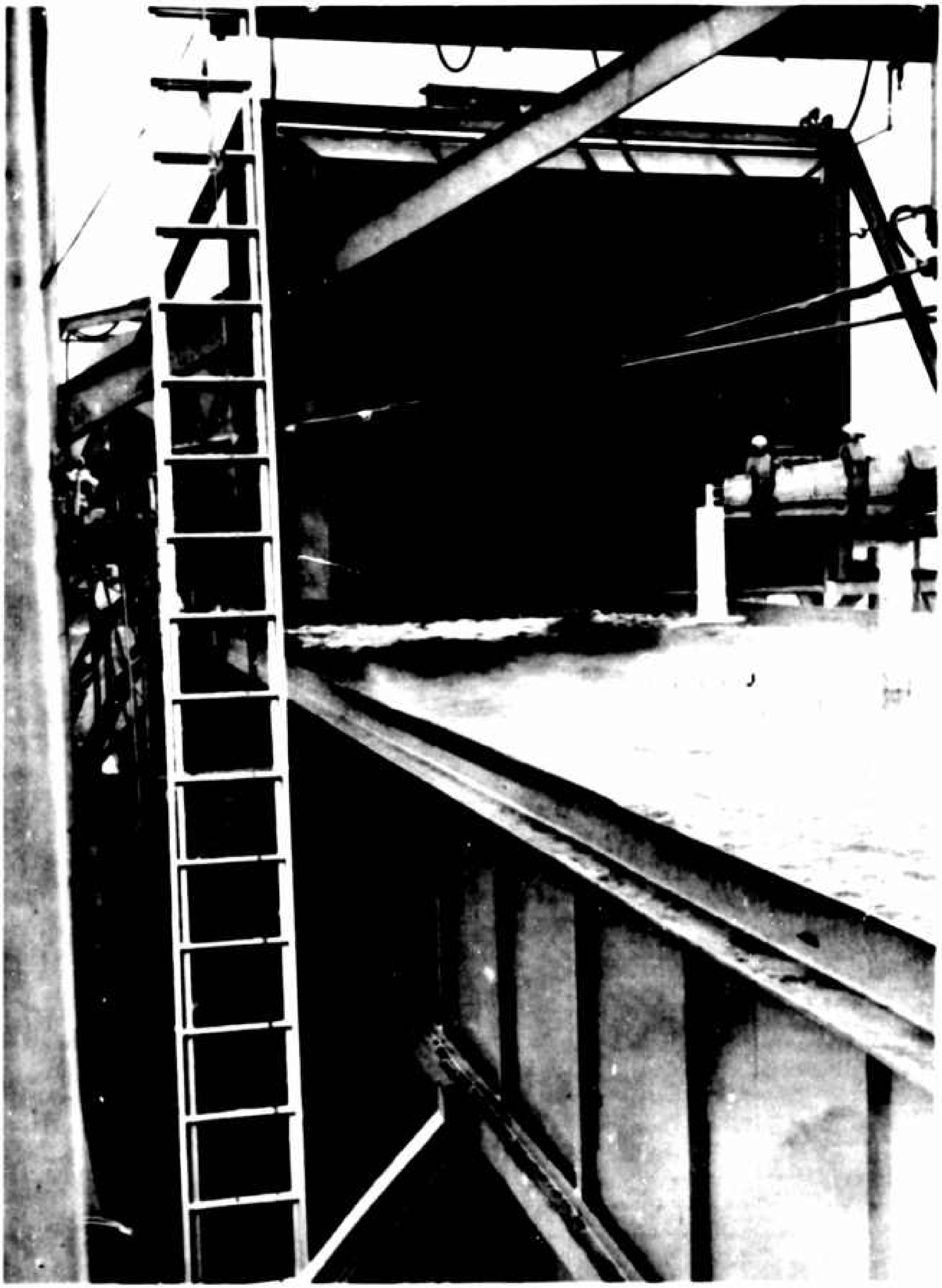


Figure 4-11 Effect of Sidewall Deflection

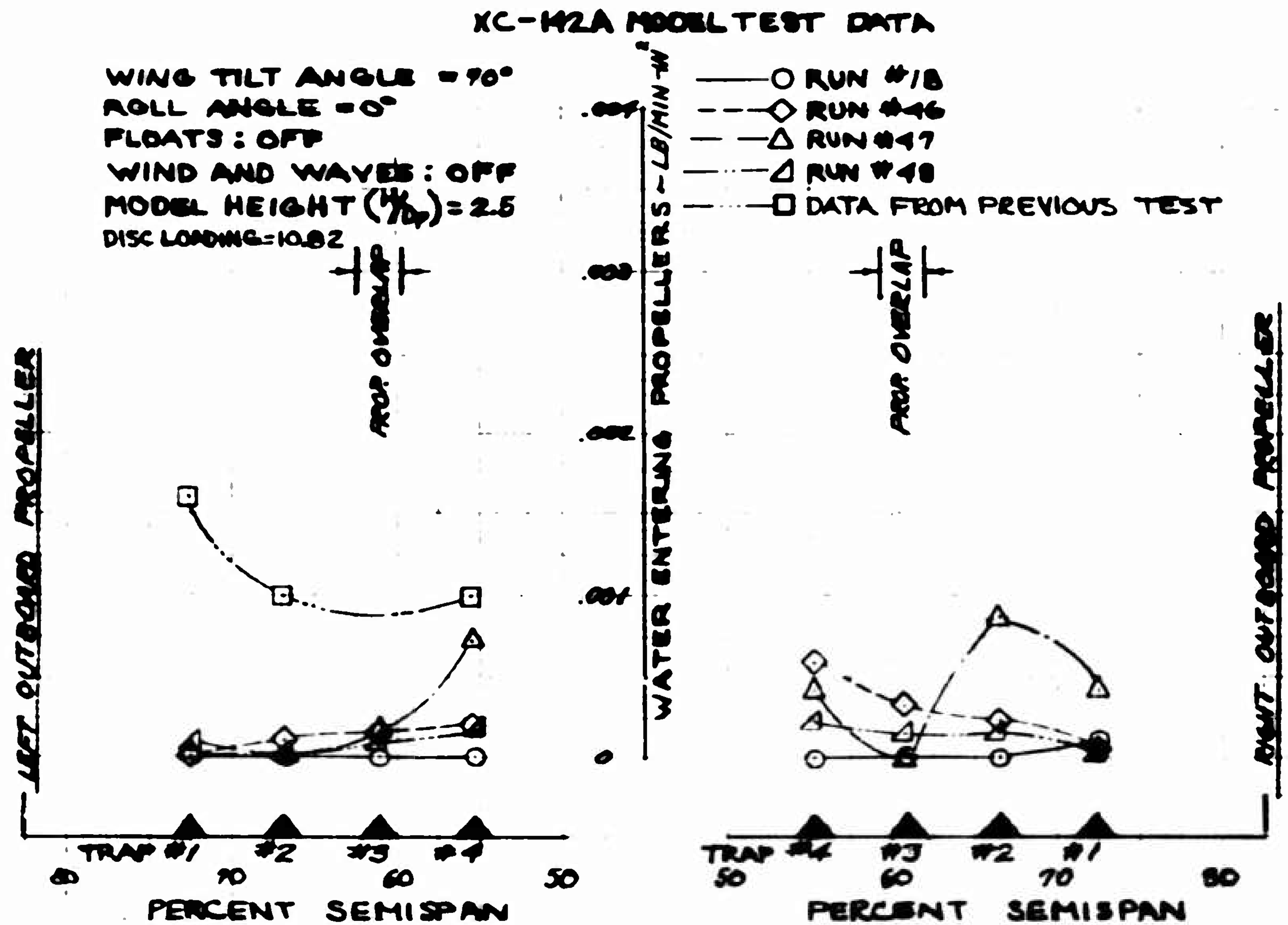


Figure 4-12 Water Entering Propellers-Repeatability

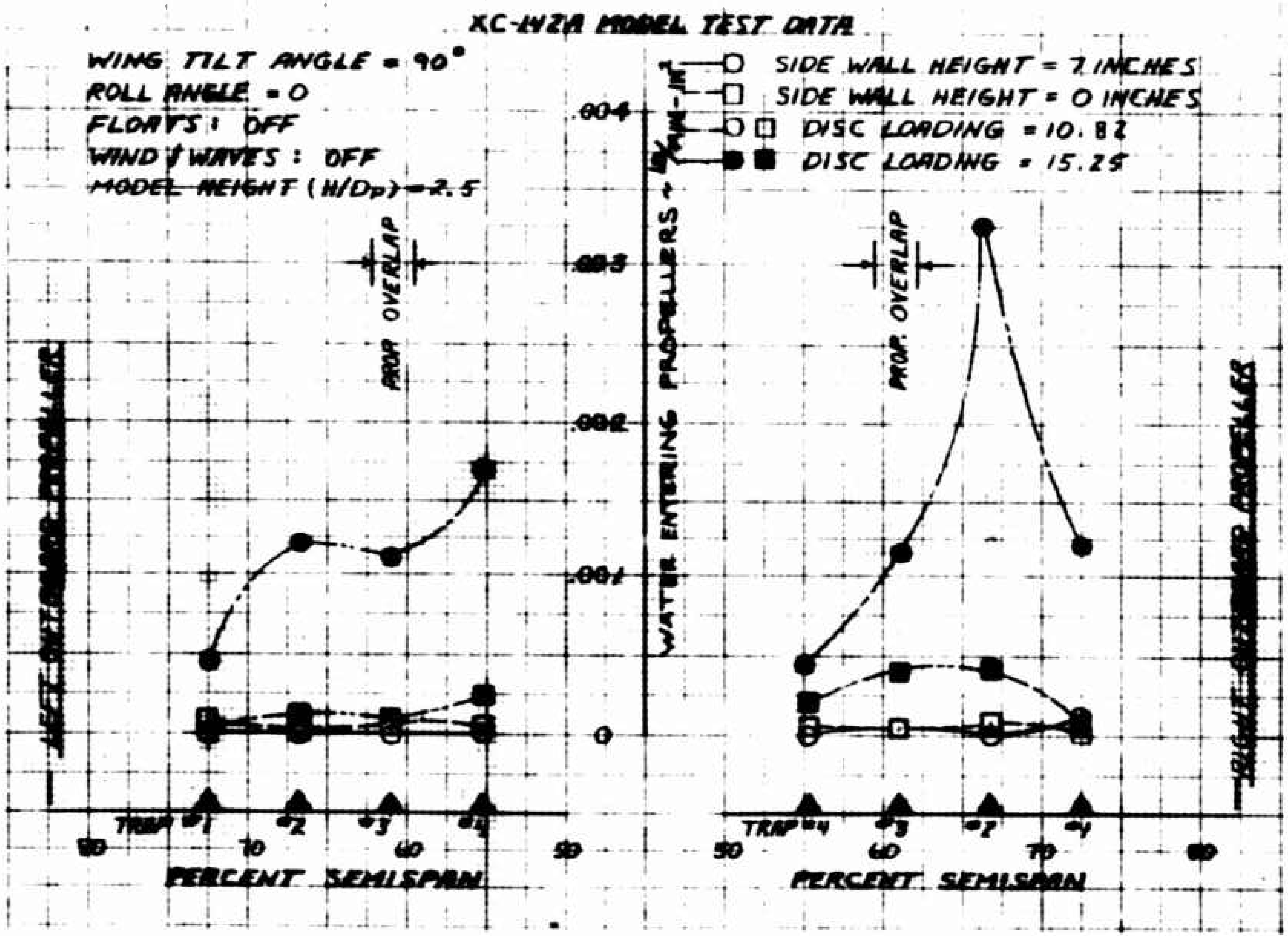


Figure 4-13 Water Entering Propellers-Effects of Side Wall

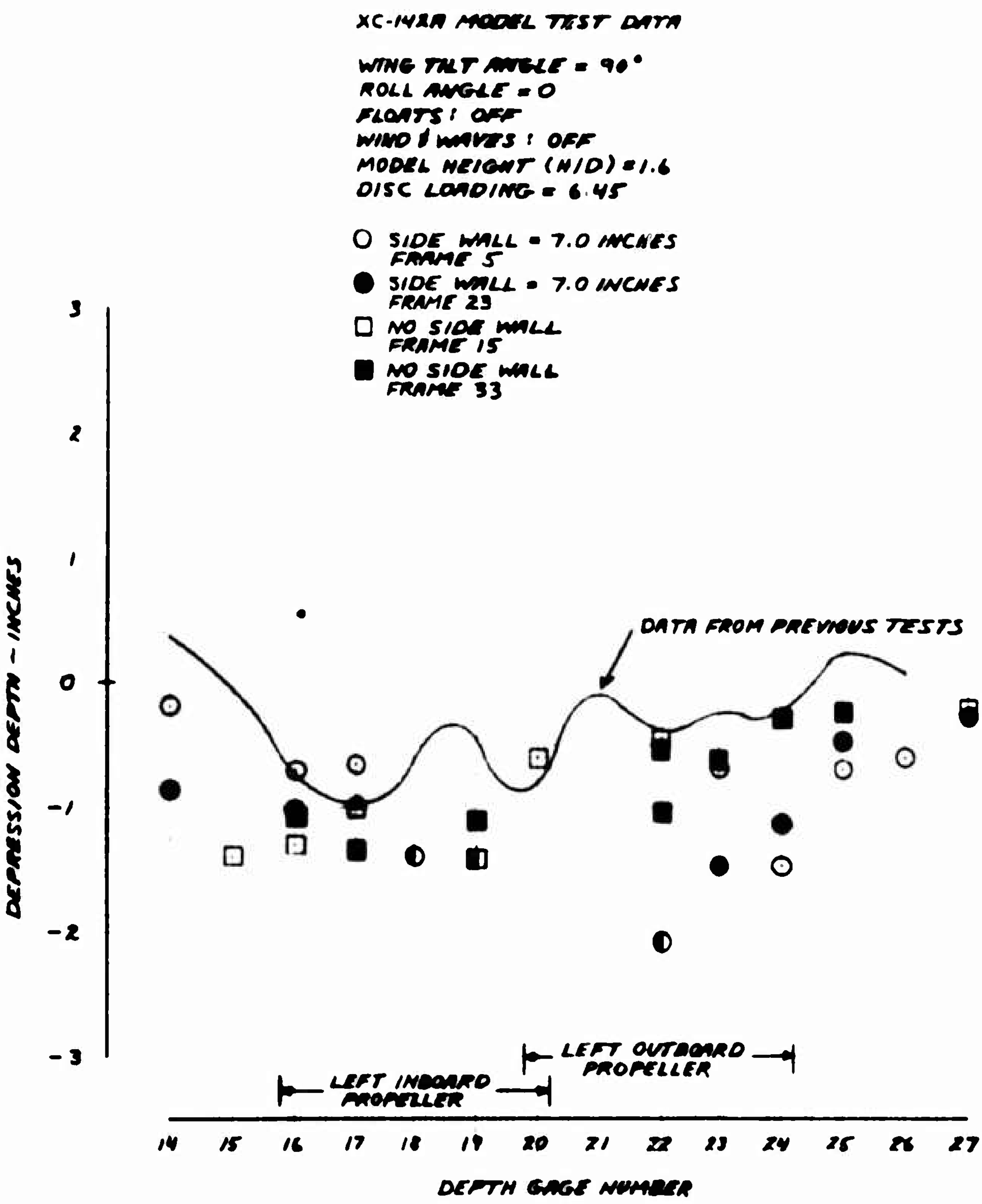


Figure 4-14 Water Displacement Along Propeller Centerline Repeatability and Effects of Side Wall

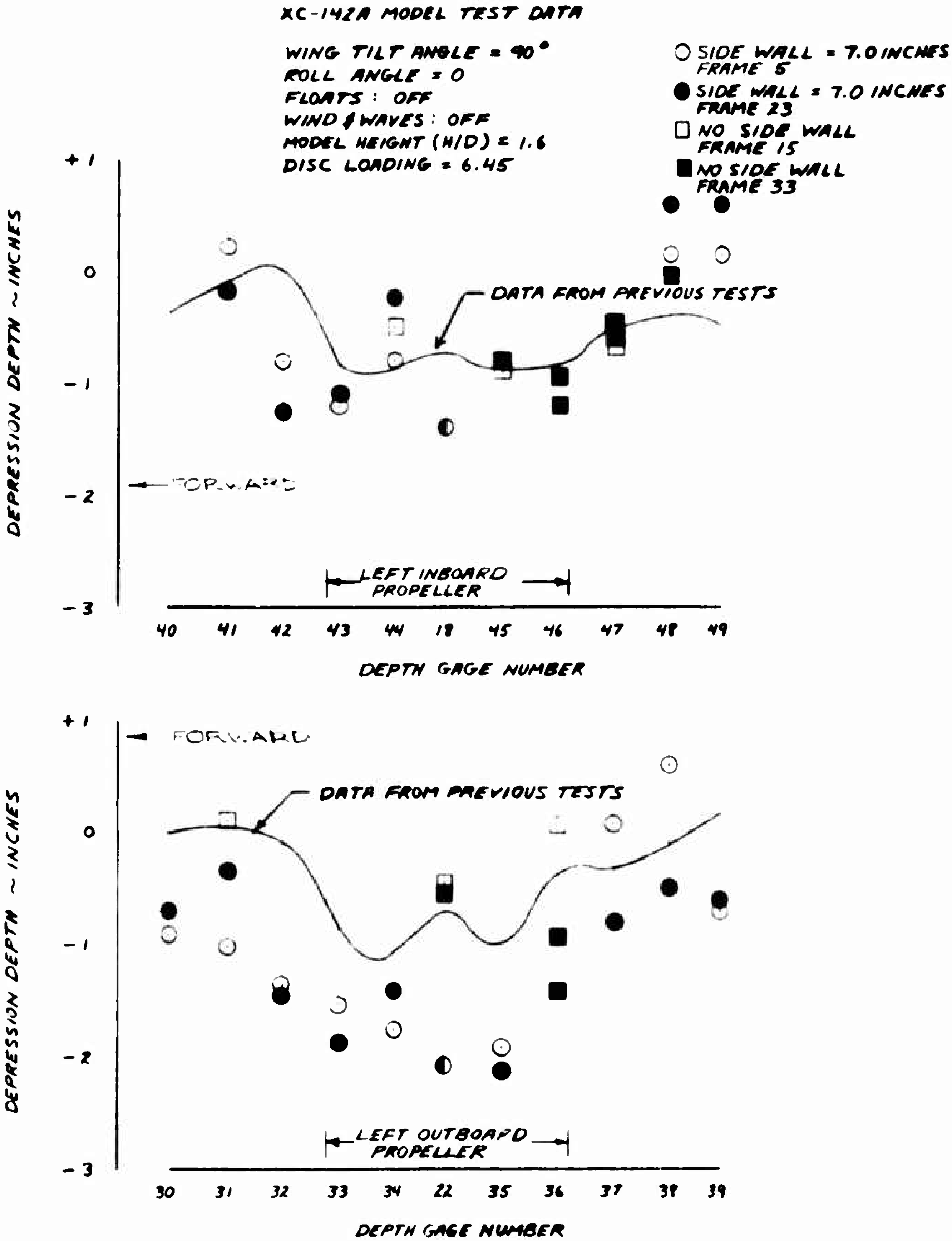


Figure 4-15 Water Displacement Fore and Aft Repeatability and Effects of Side Wall

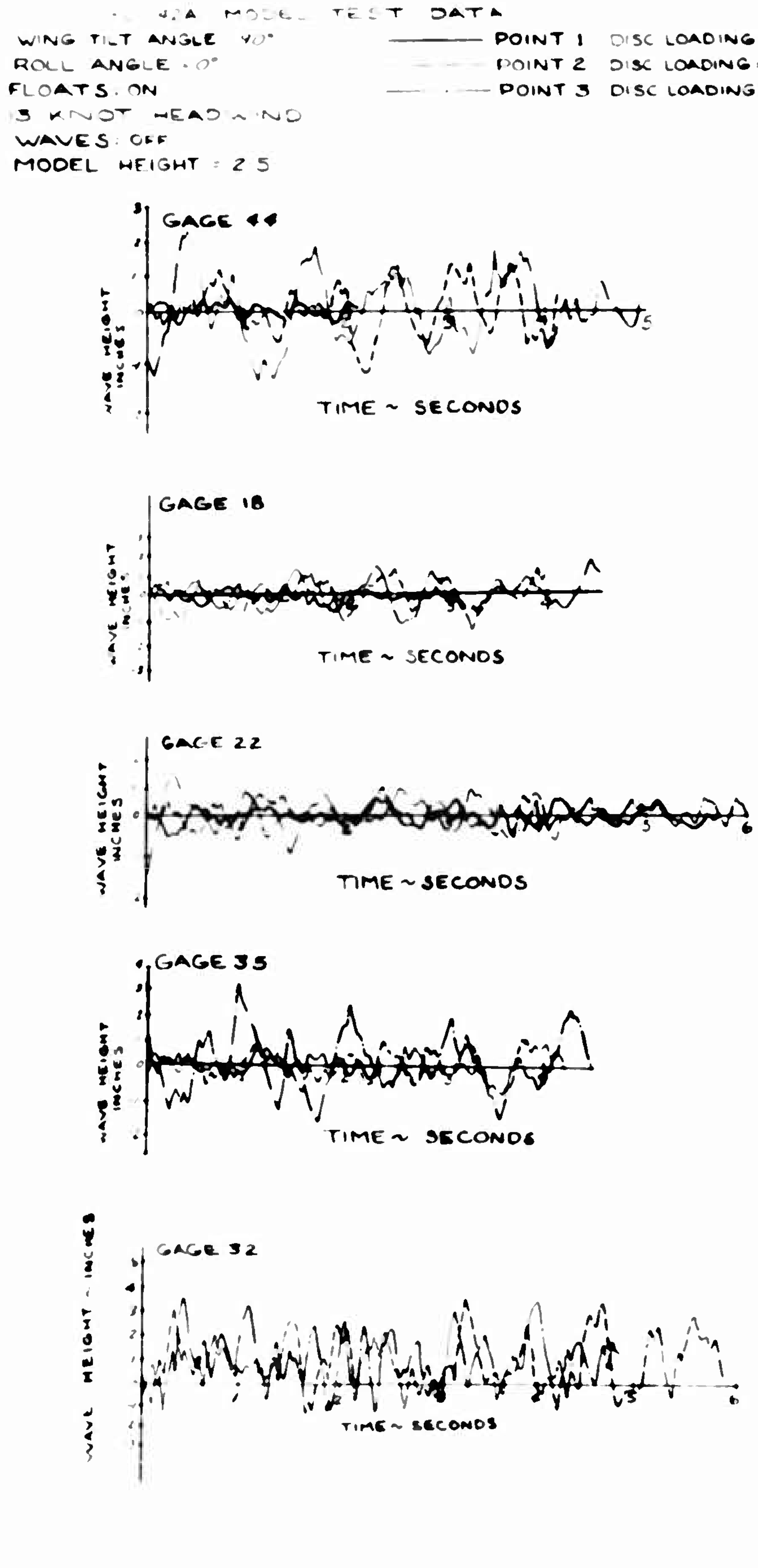


Figure 4-16 Effects of Time

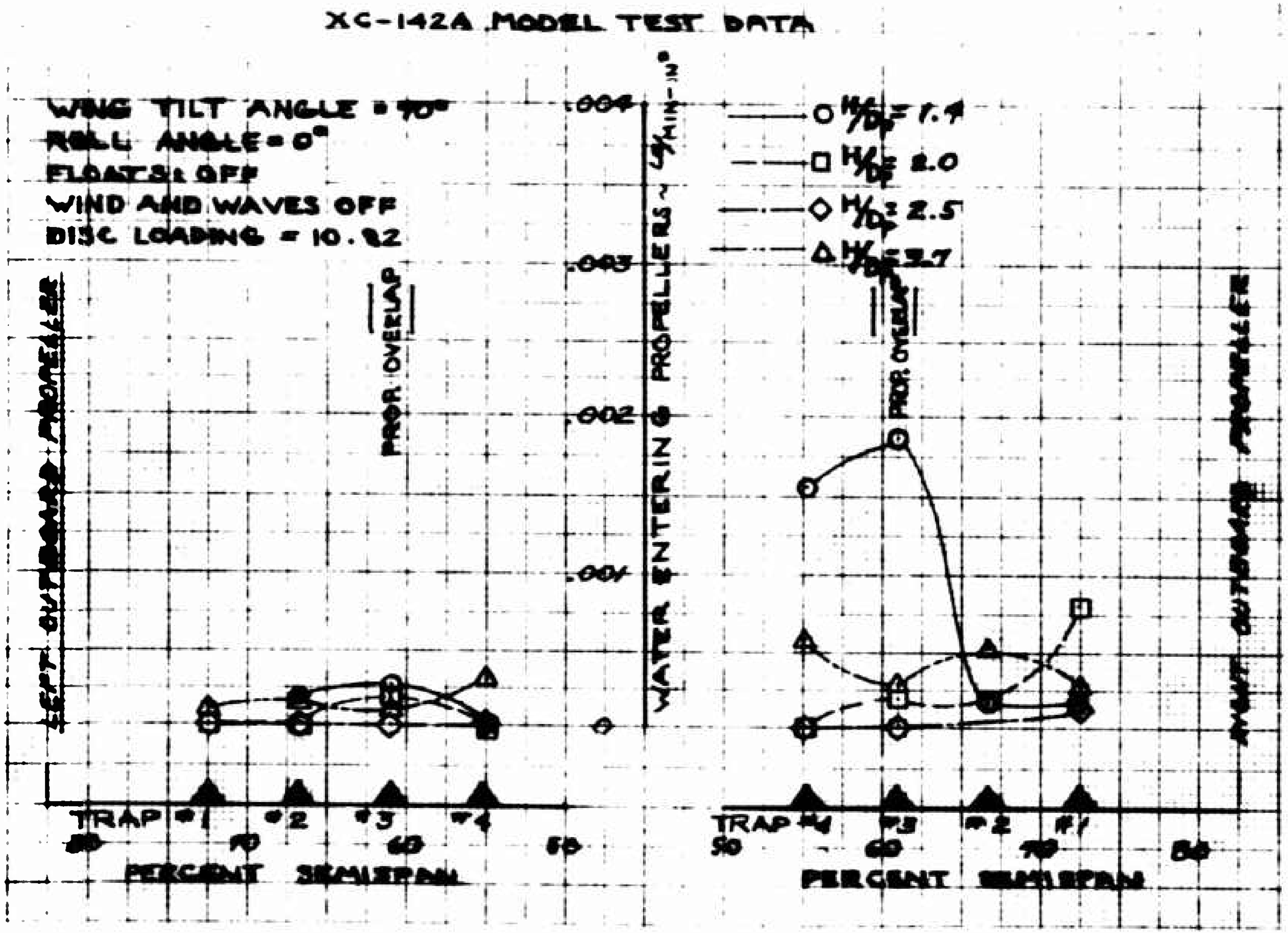


Figure 4-17 Water Entering Propellers - Effects of Model Height

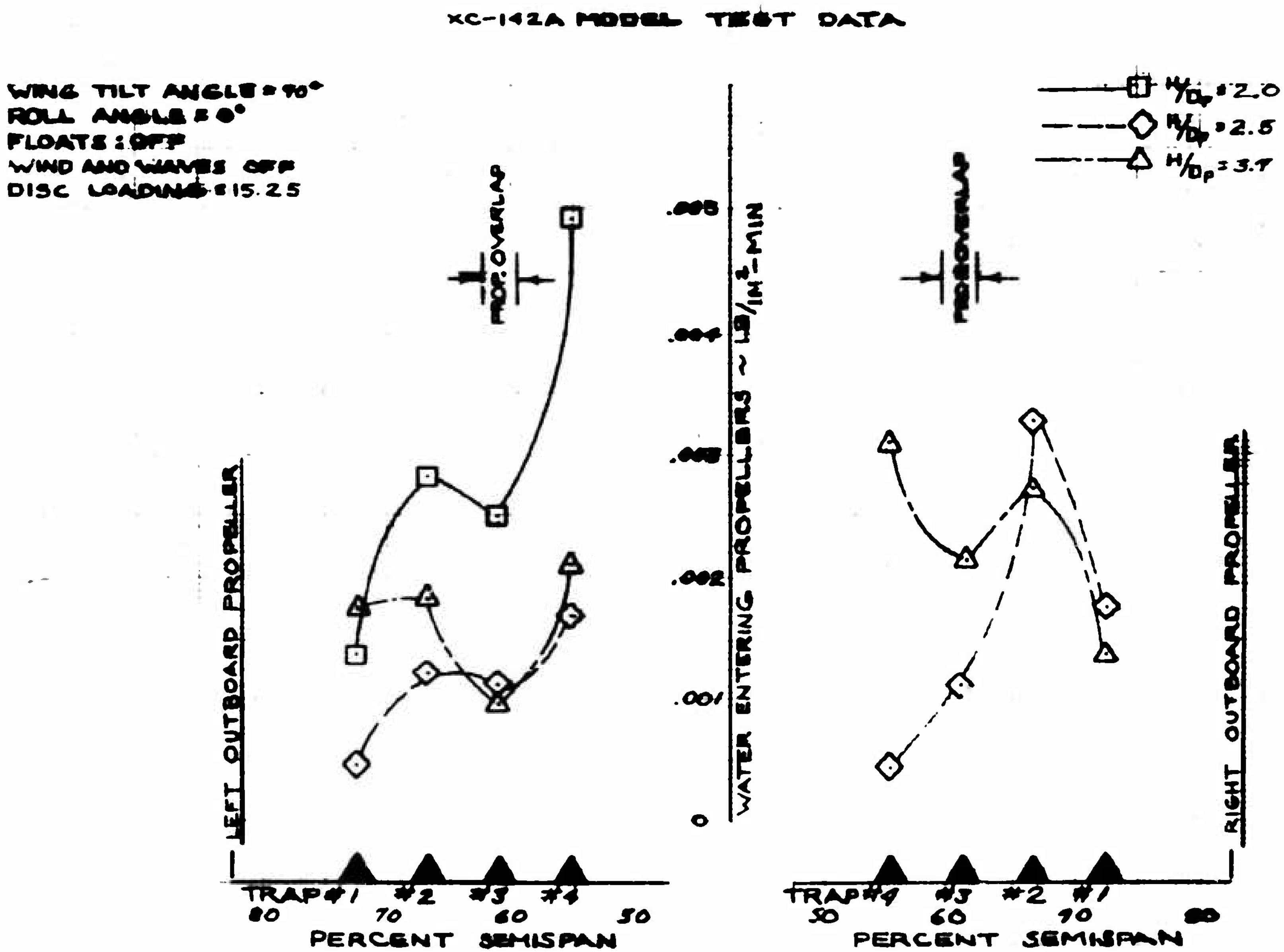


Figure 4-18 Water Entering Propellers - Effects of Model Height

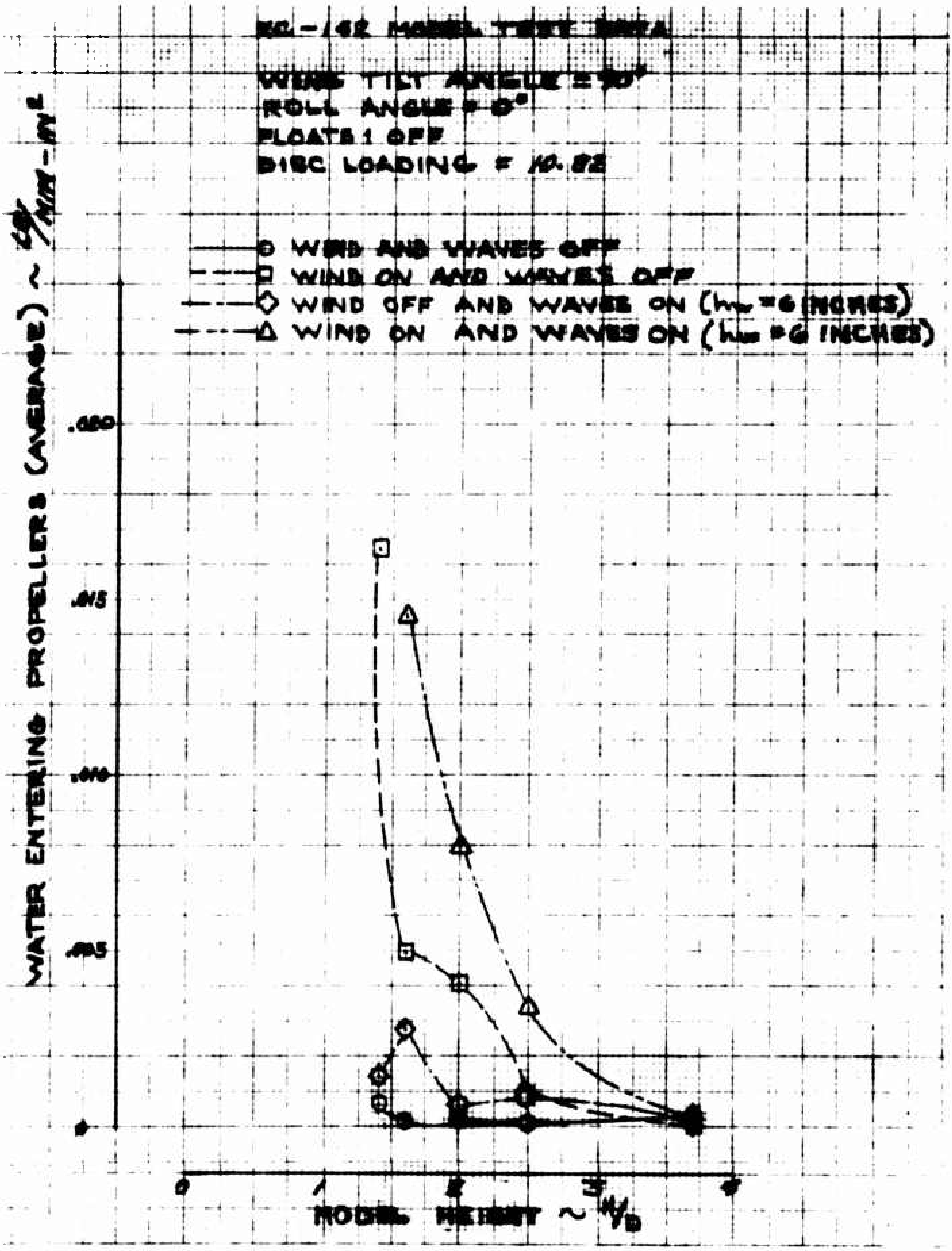


Figure 4-19 Water Entering Propellers -
Effects of Model Height

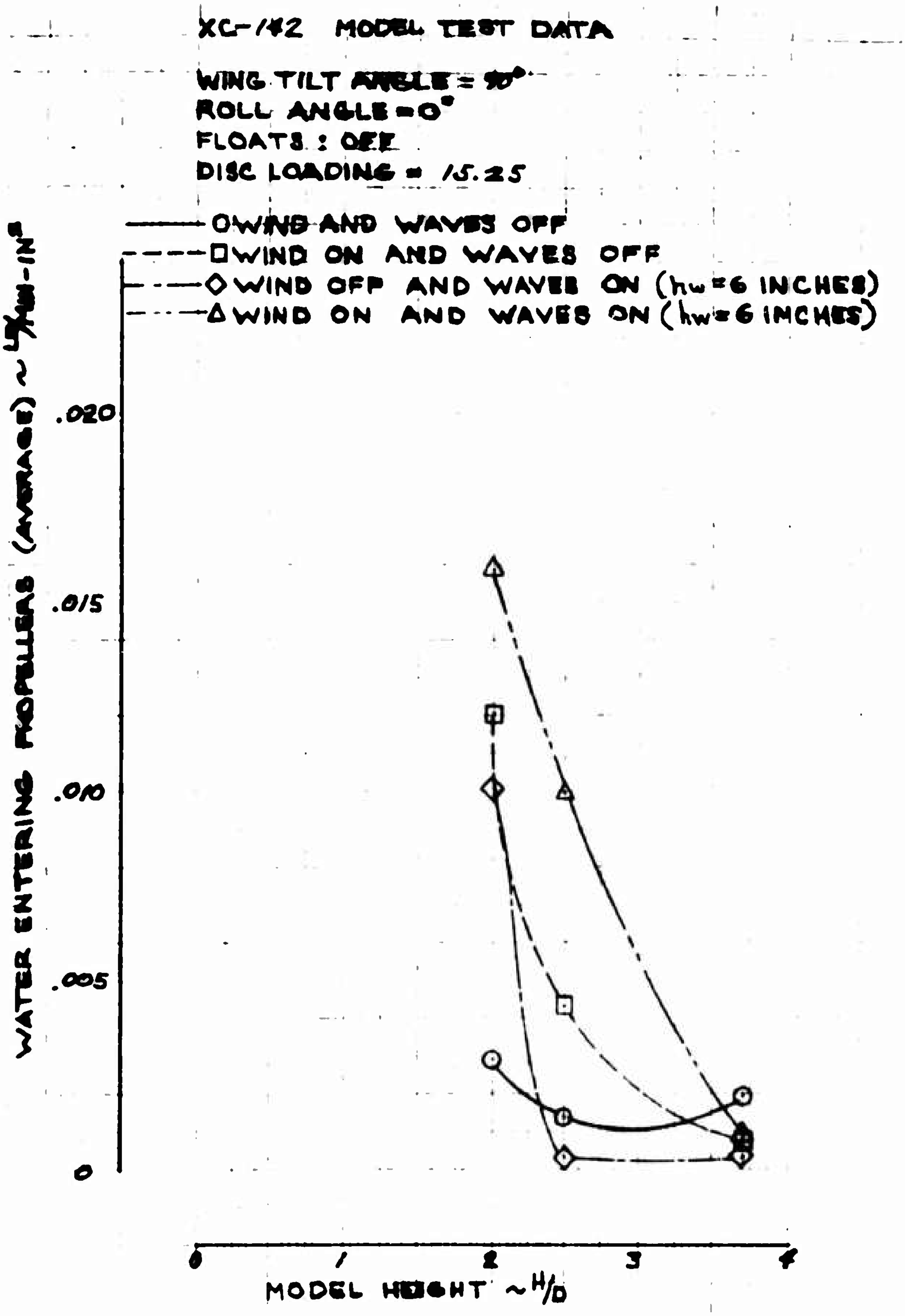


Figure 4-20 Water Entering Propellers - Effects of Model Height

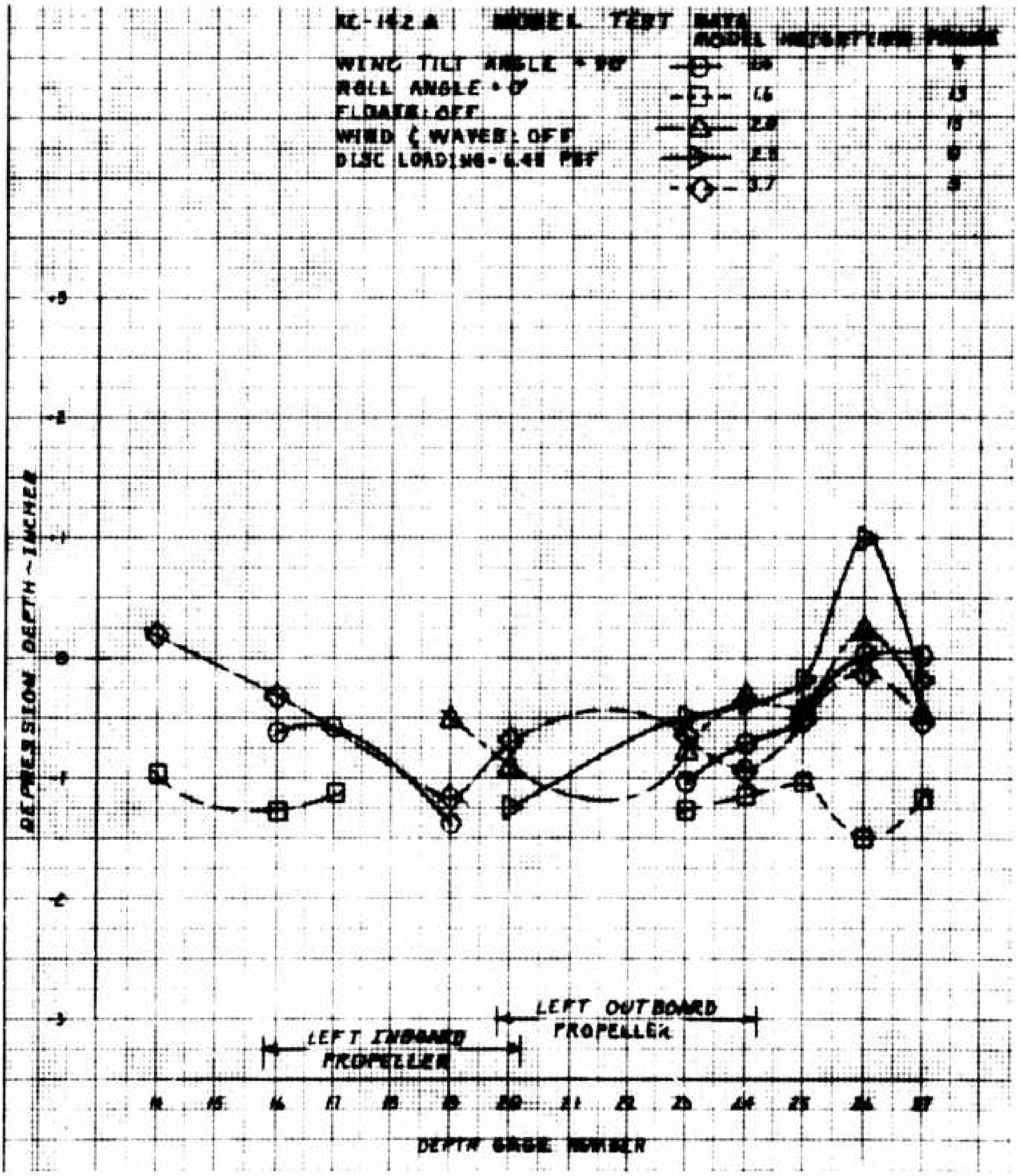


Figure 4-21 Water Displacement Along Propeller Centerline — Effects of Model Height

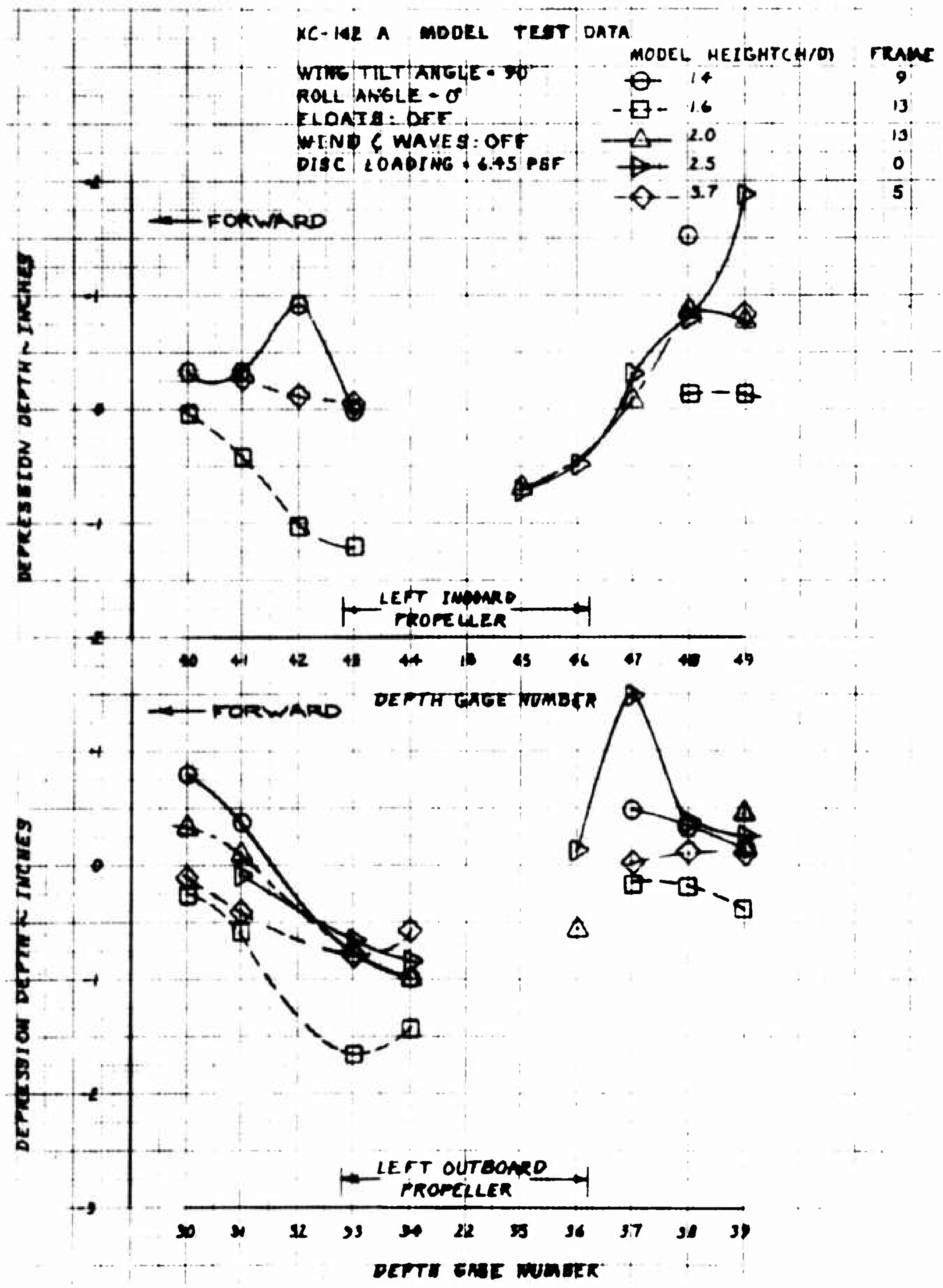


Figure 4-22 Water Displacement Fore and Aft - Effects of Model Height

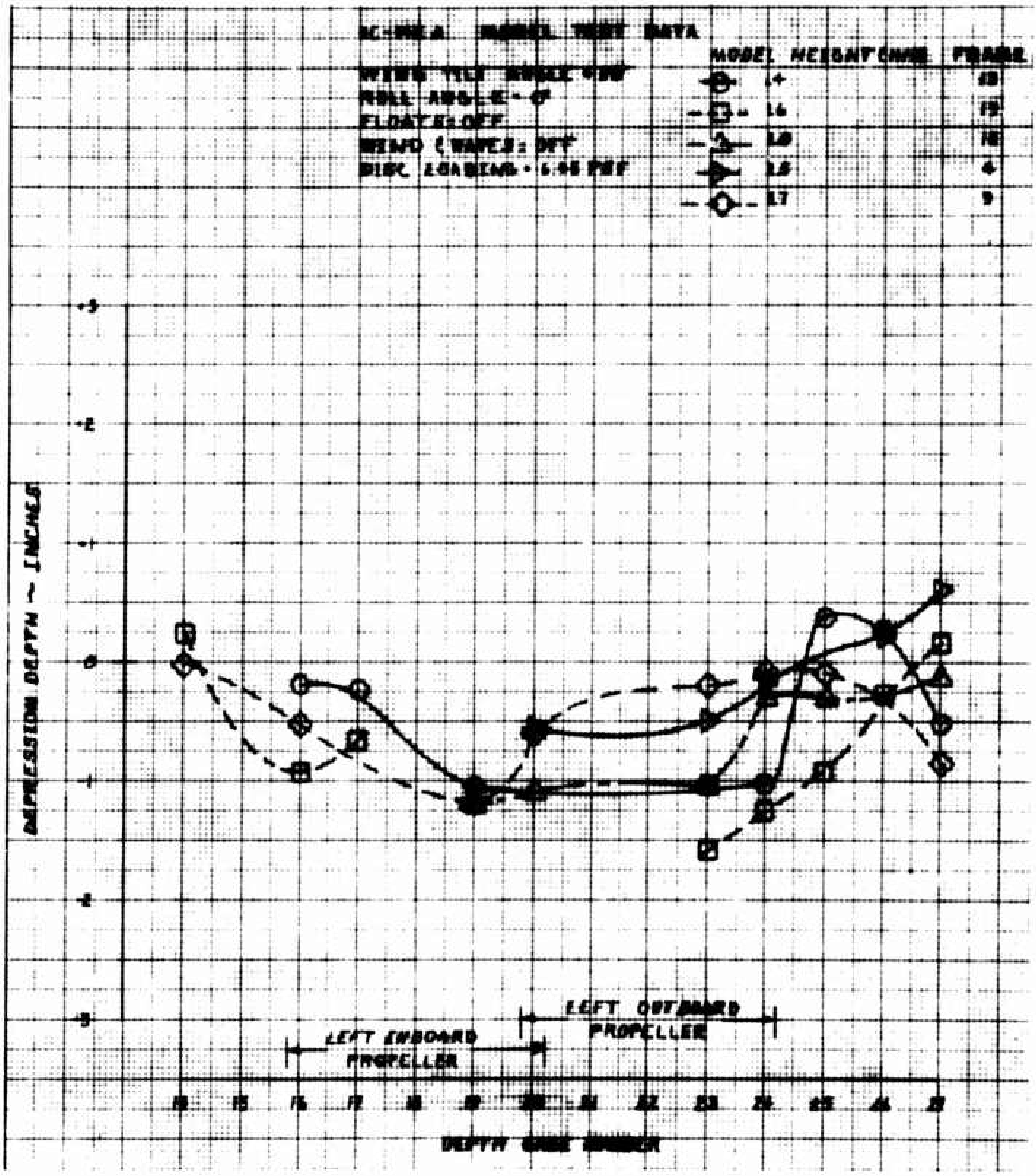


Figure 4-23 Water Displacement Along Propeller Centerline - Effects of Model Height

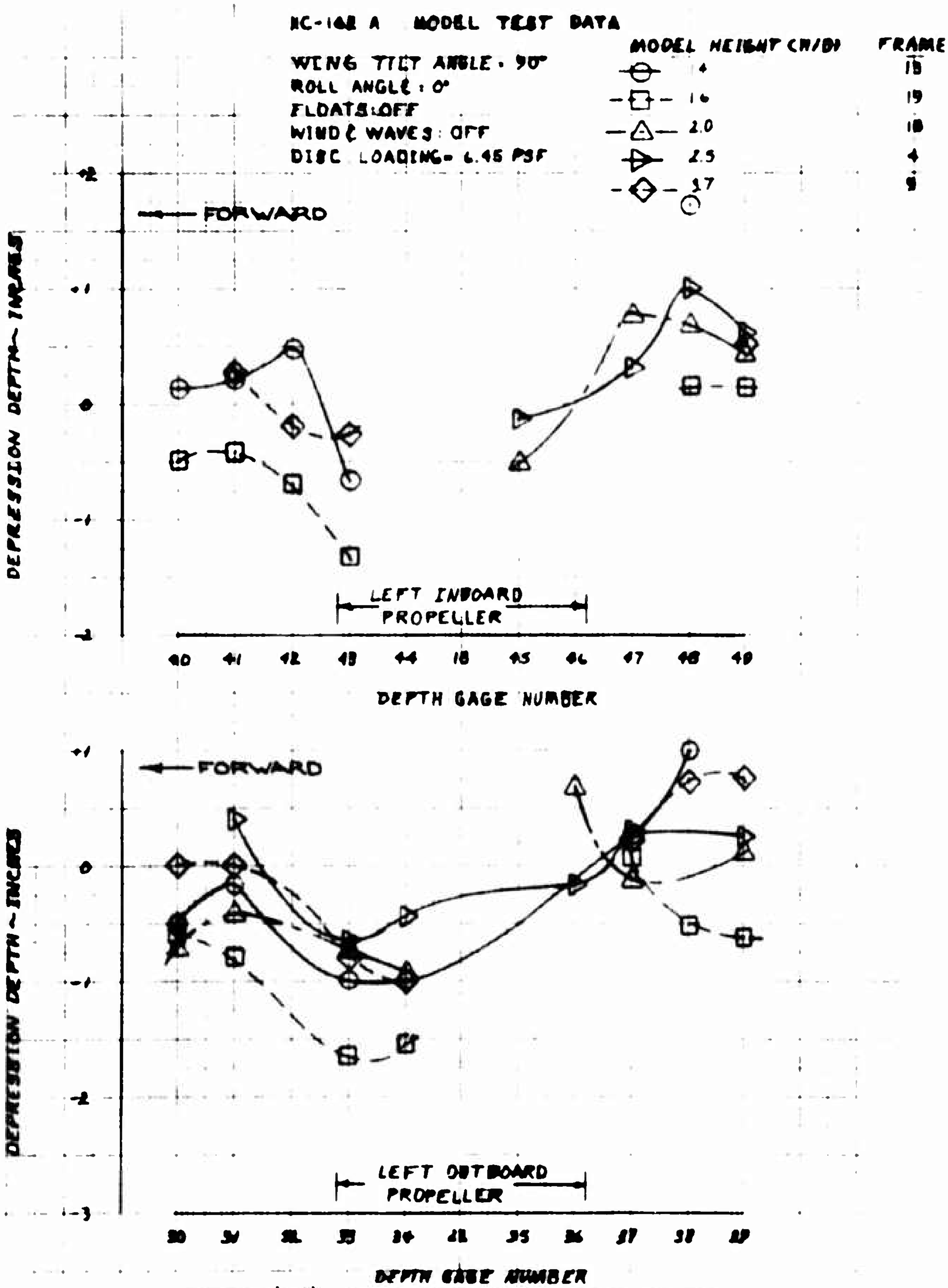


Figure 4-24 Water Displacement Fore and Aft – Effects of Model Height

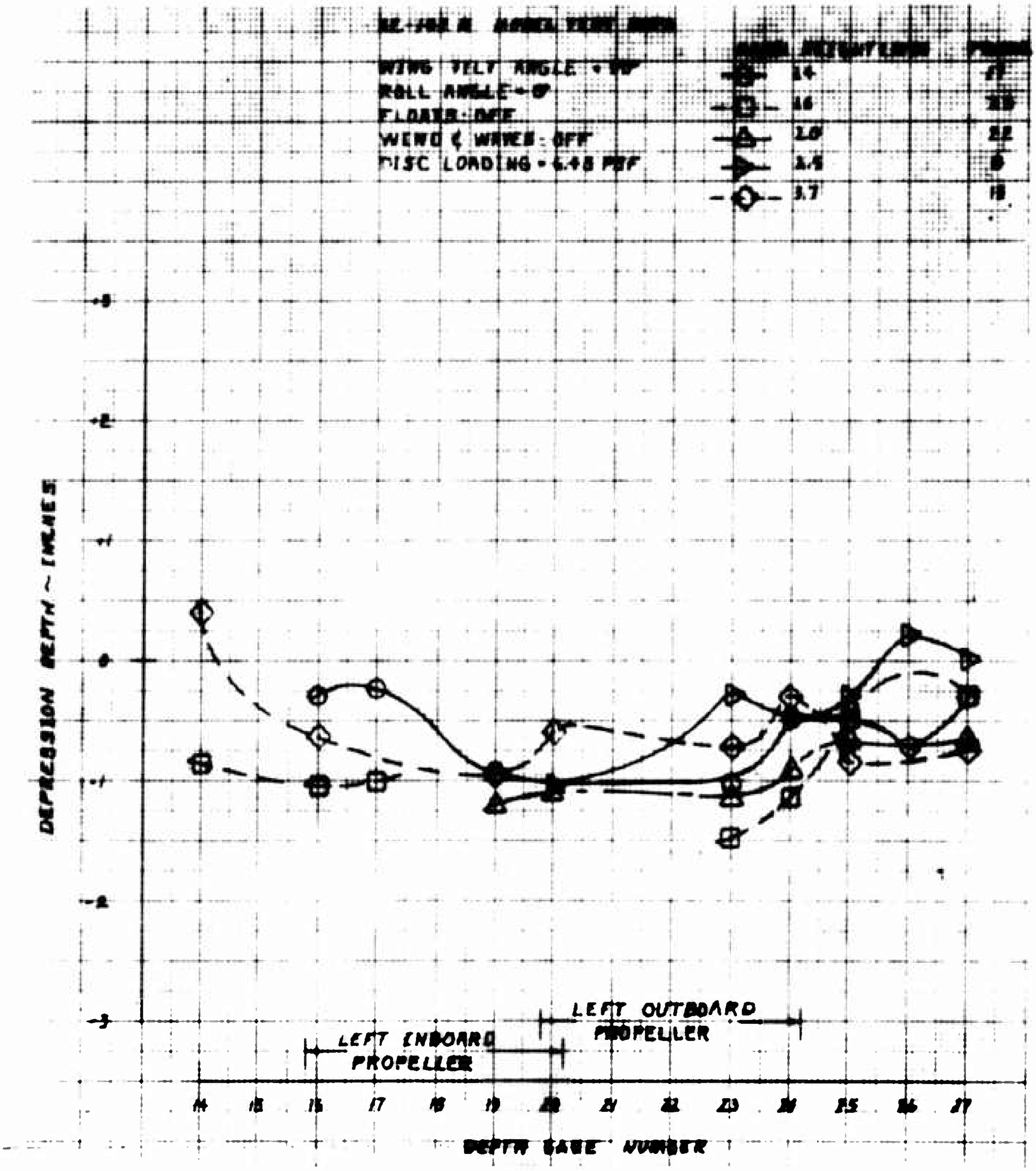


Figure 4-25 Water Displacement Along Propeller Centerline - Effects of Model Height

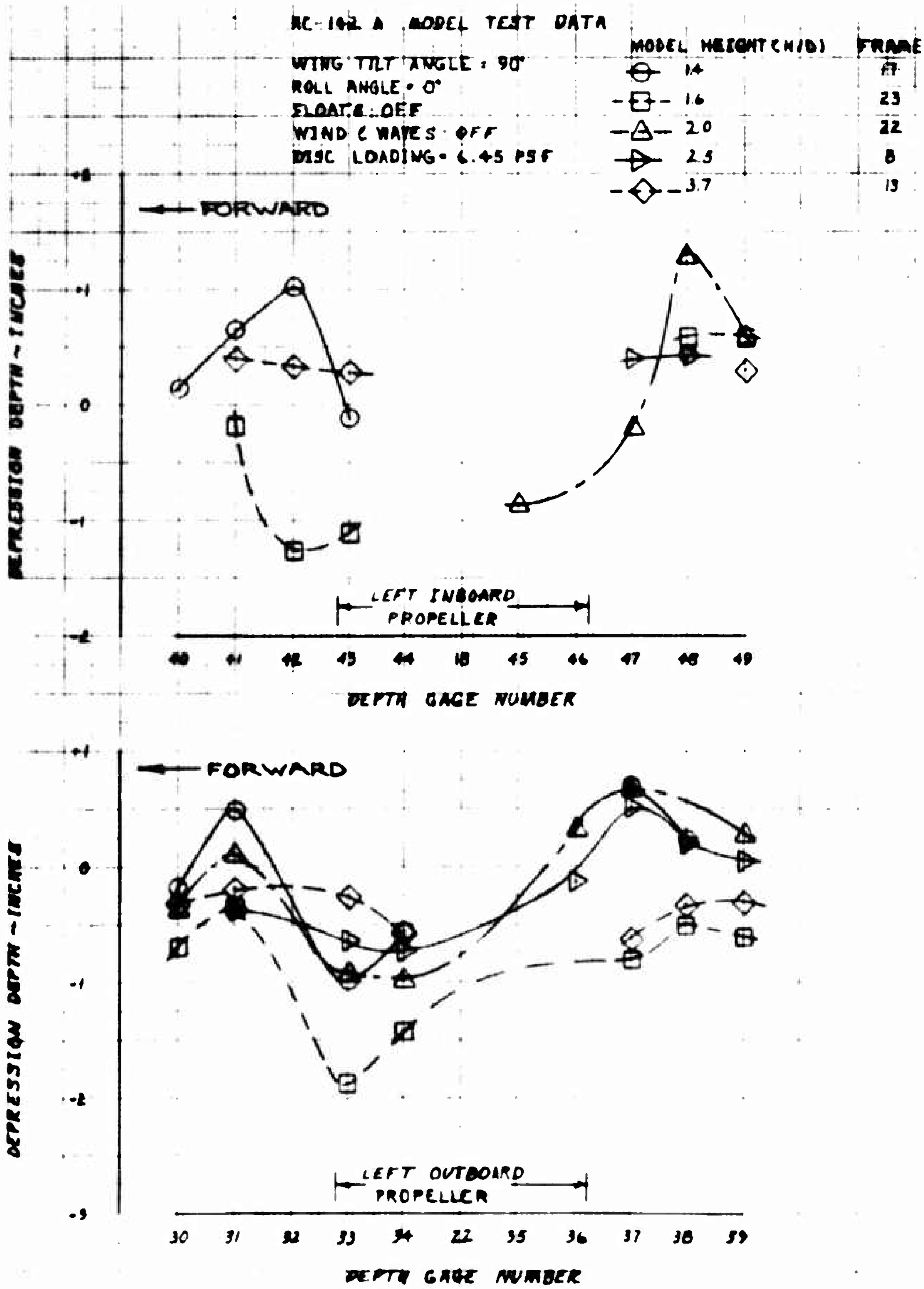


Figure 4-26 Water Displacement Fore and Aft - Effects of Model Height

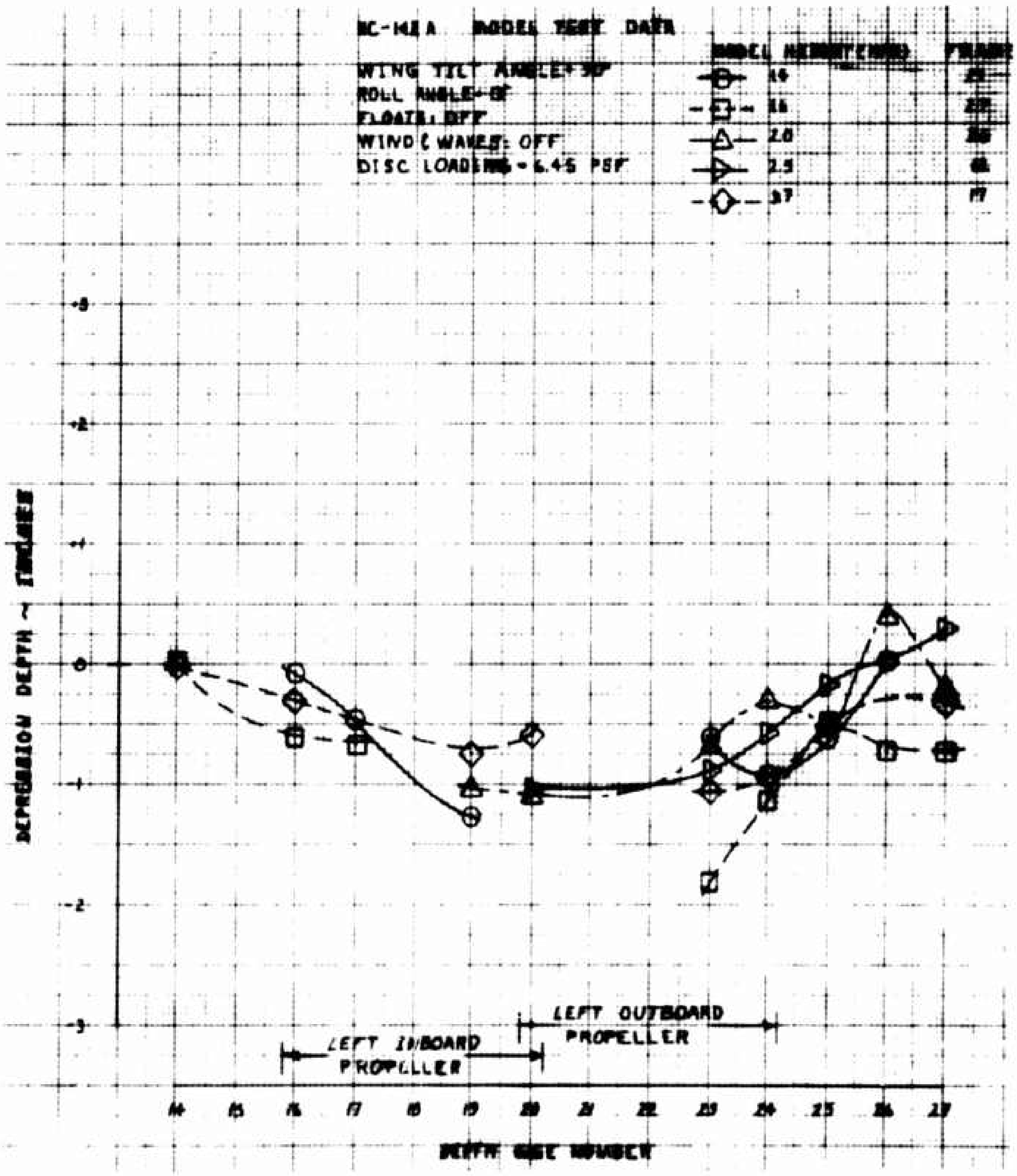


Figure 4-27 Water Displacement Along Propeller Centerline – Effects of Model Height

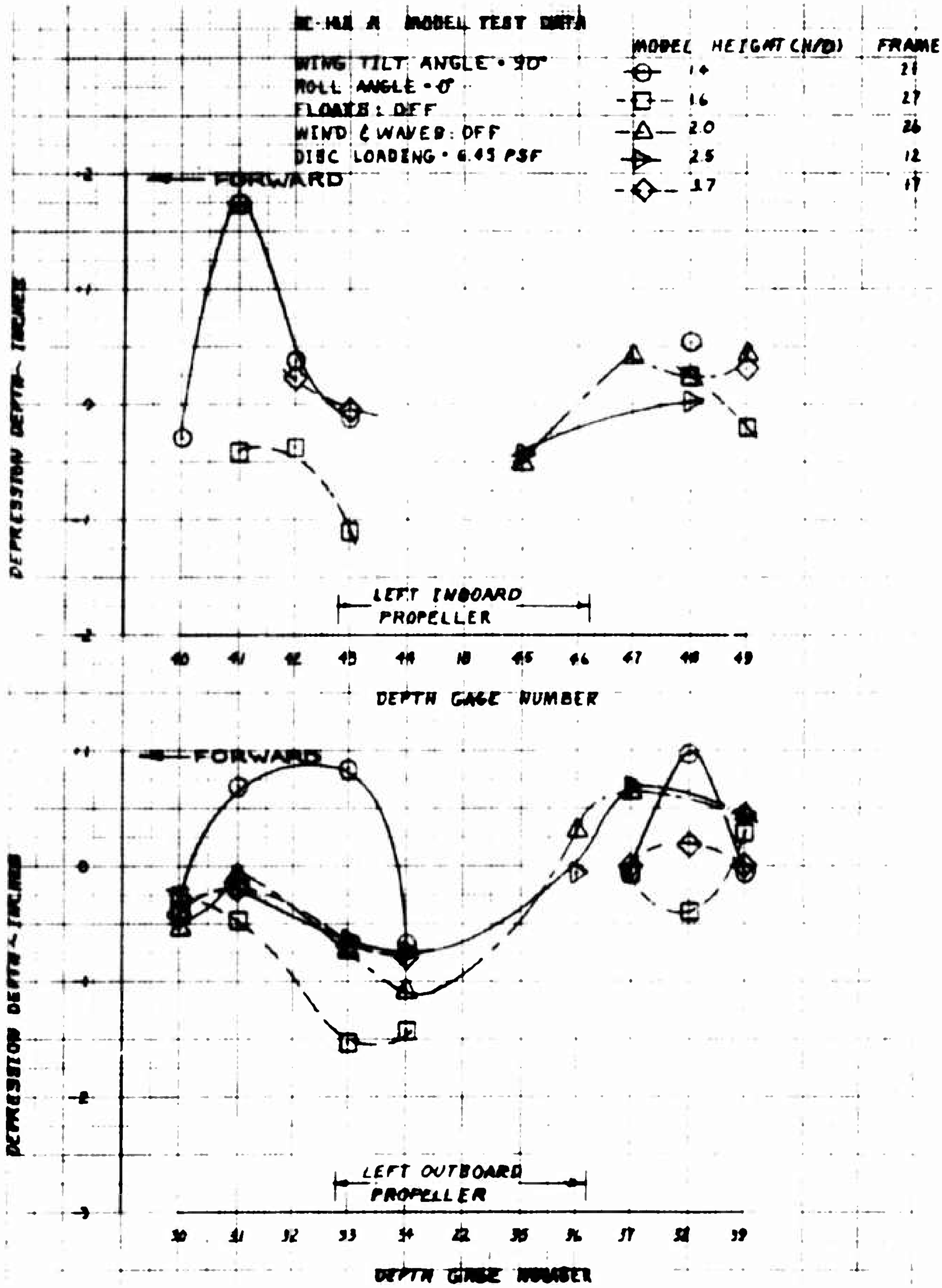


Figure 4-28 Water Displacement Fore and Aft - Effects of Model Height

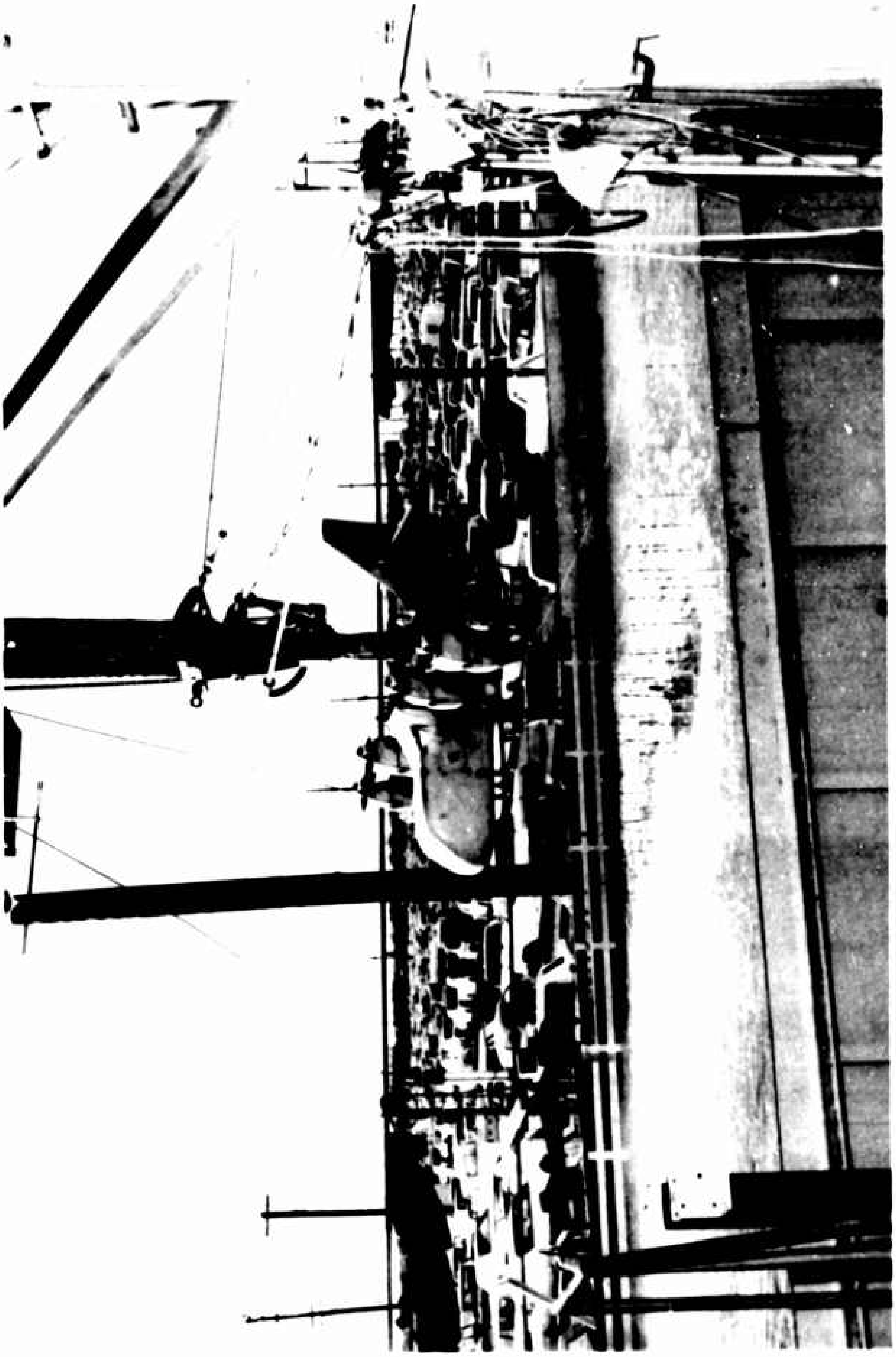


Figure 4-29 Model at 6.45 PSF Disc Loading

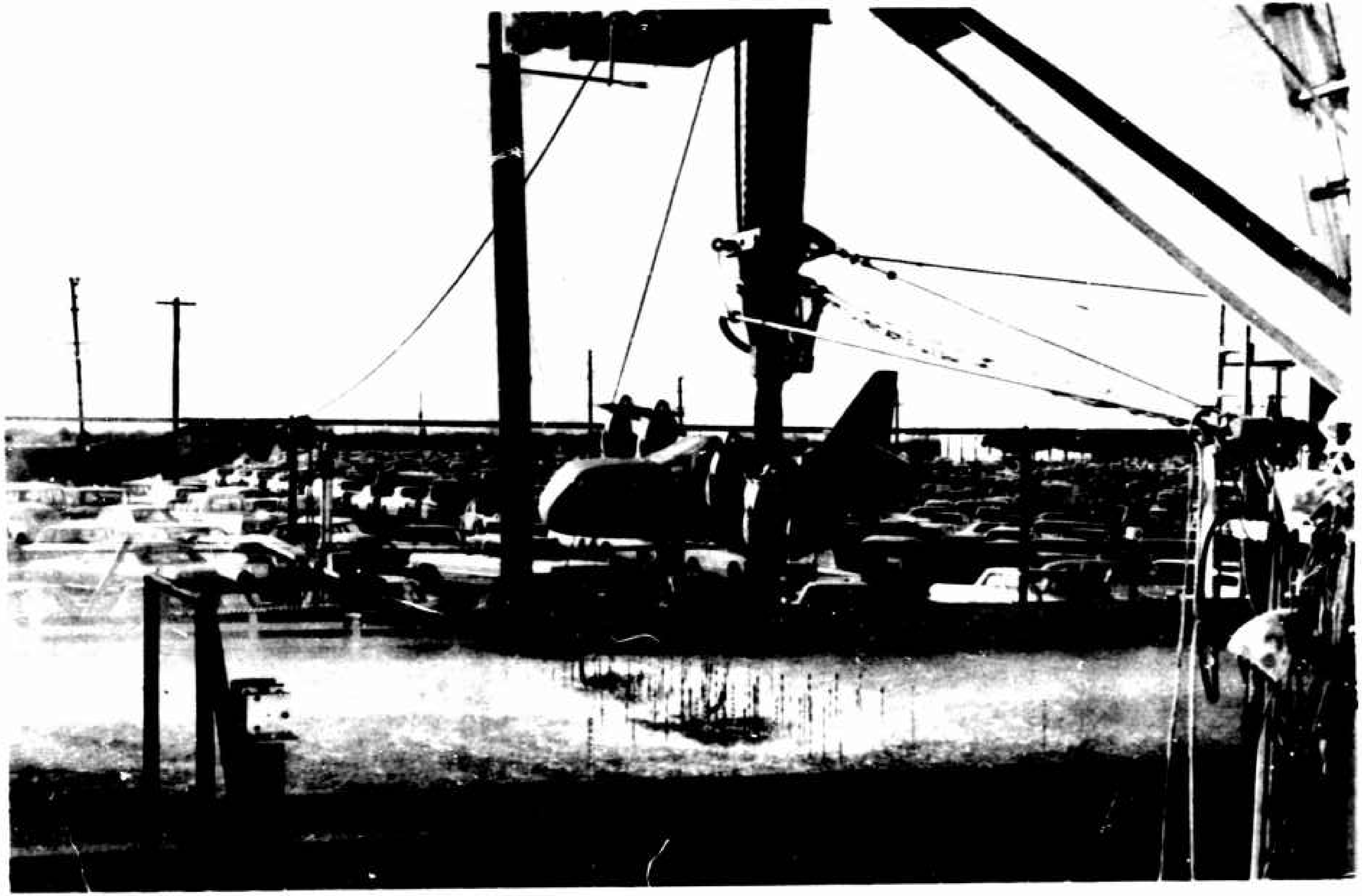


Figure 4-30 Model at 10.82 PSF Disc Loading

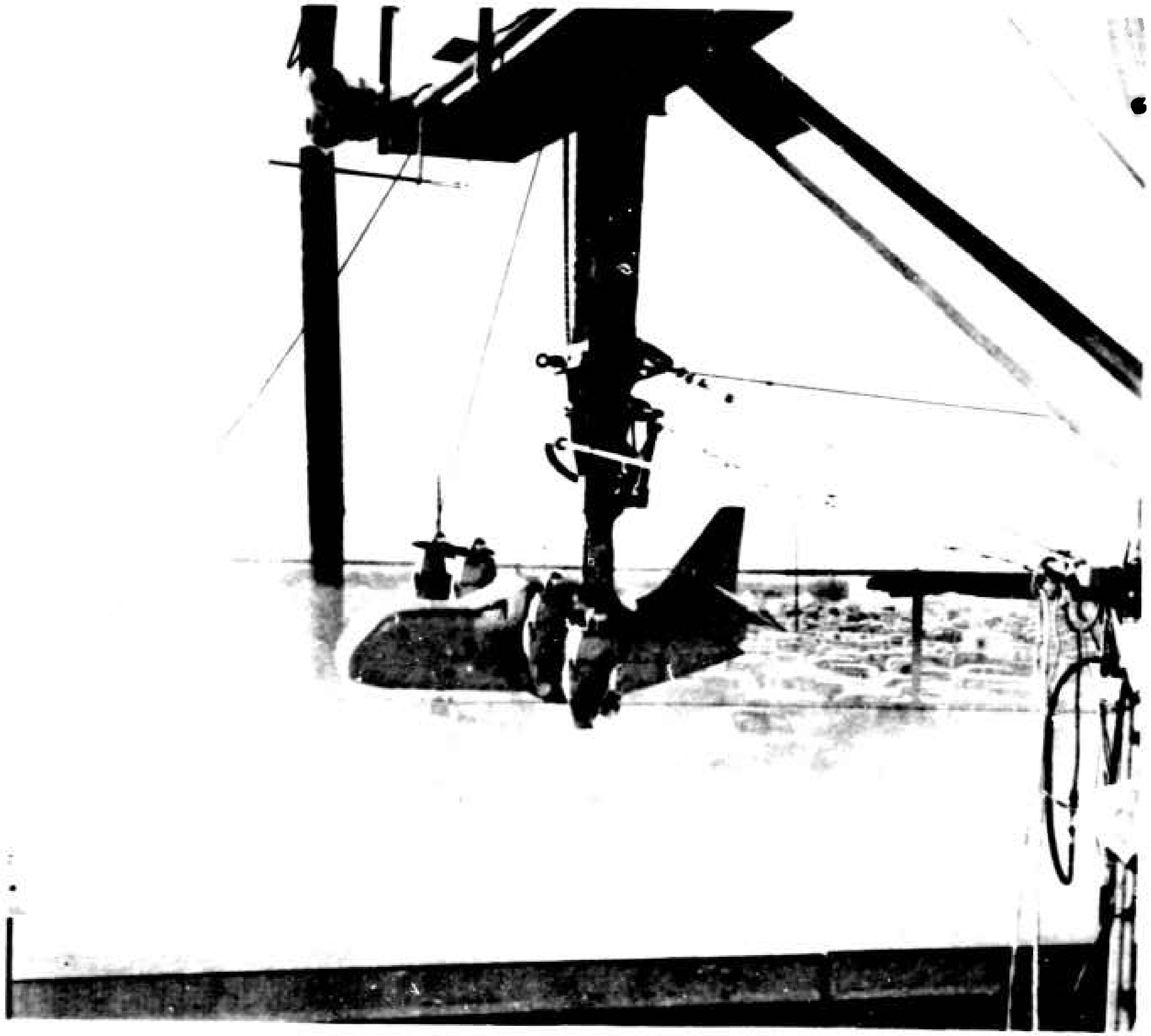


Figure 4-31 Model at 15.25 PSF Disc Loading

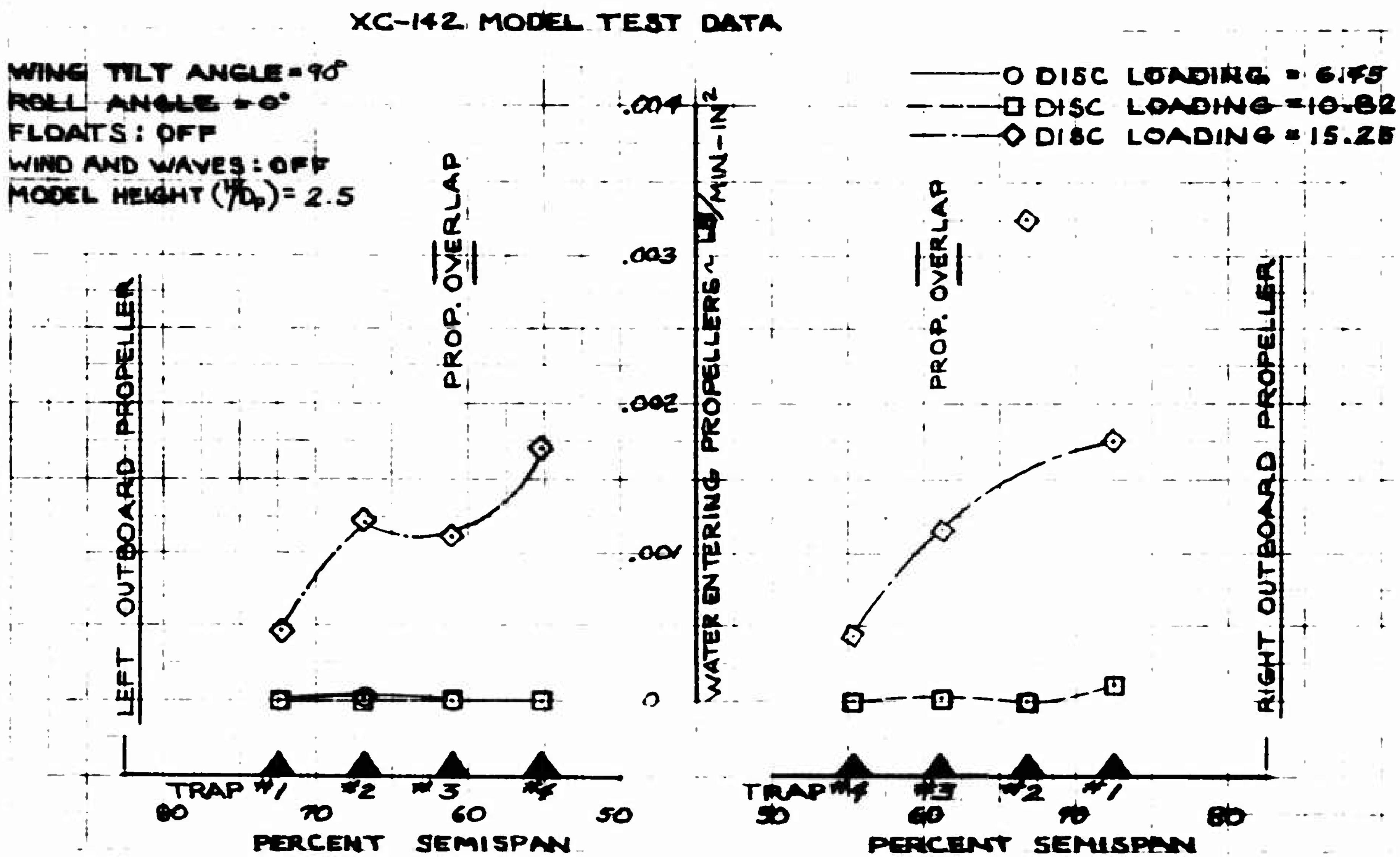


Figure 4-32 Water Entering Propellers – Effects of Disc Loading

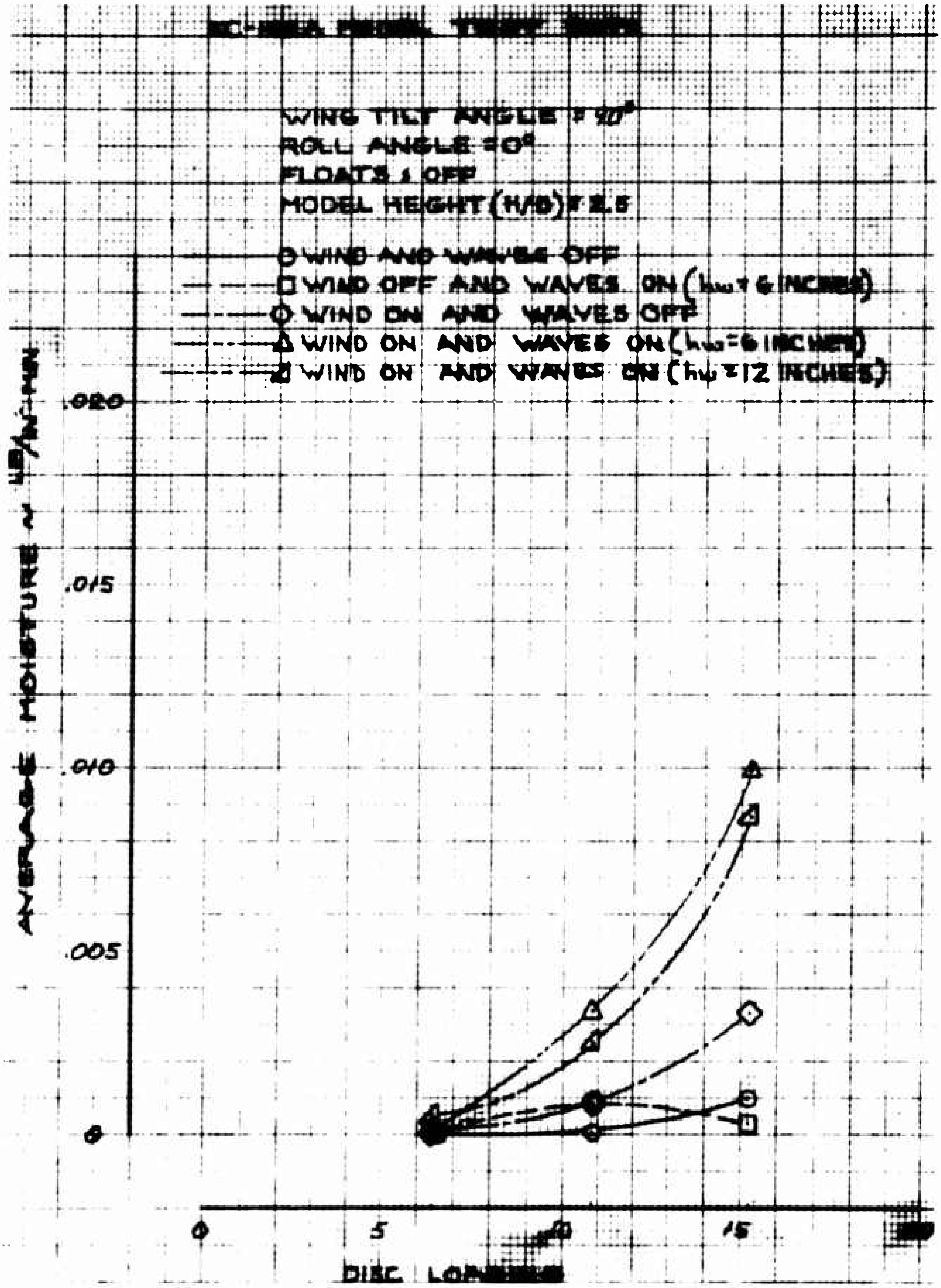


Figure 4-33 Water Entering Propellers - Effects of Disc Loading

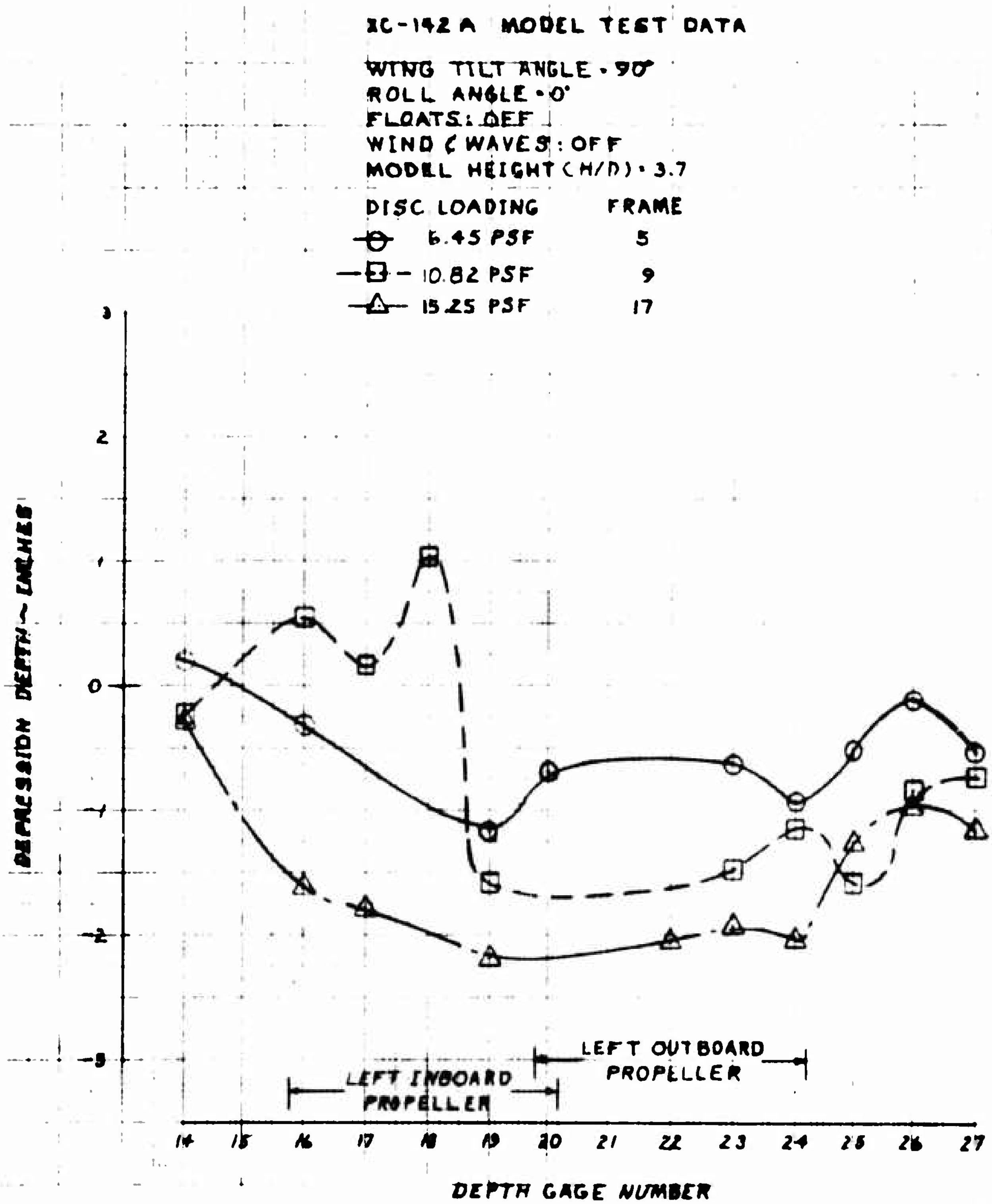


Figure 4-34 Water Displacement Along Propeller Centerline - Effects of Disc Loading

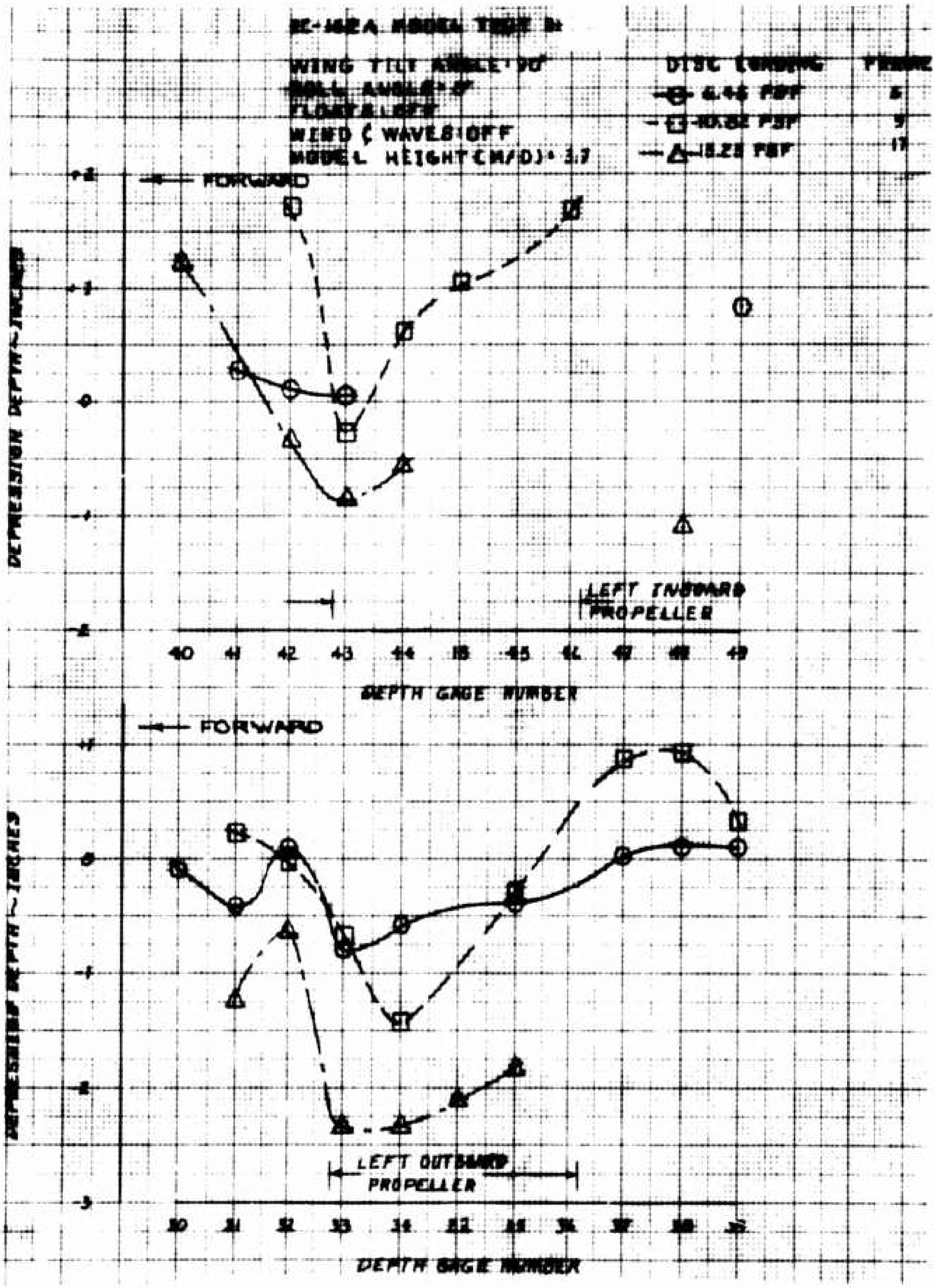


Figure 4-35 Water Displacement Fore and Aft - Effects of Disc Loading

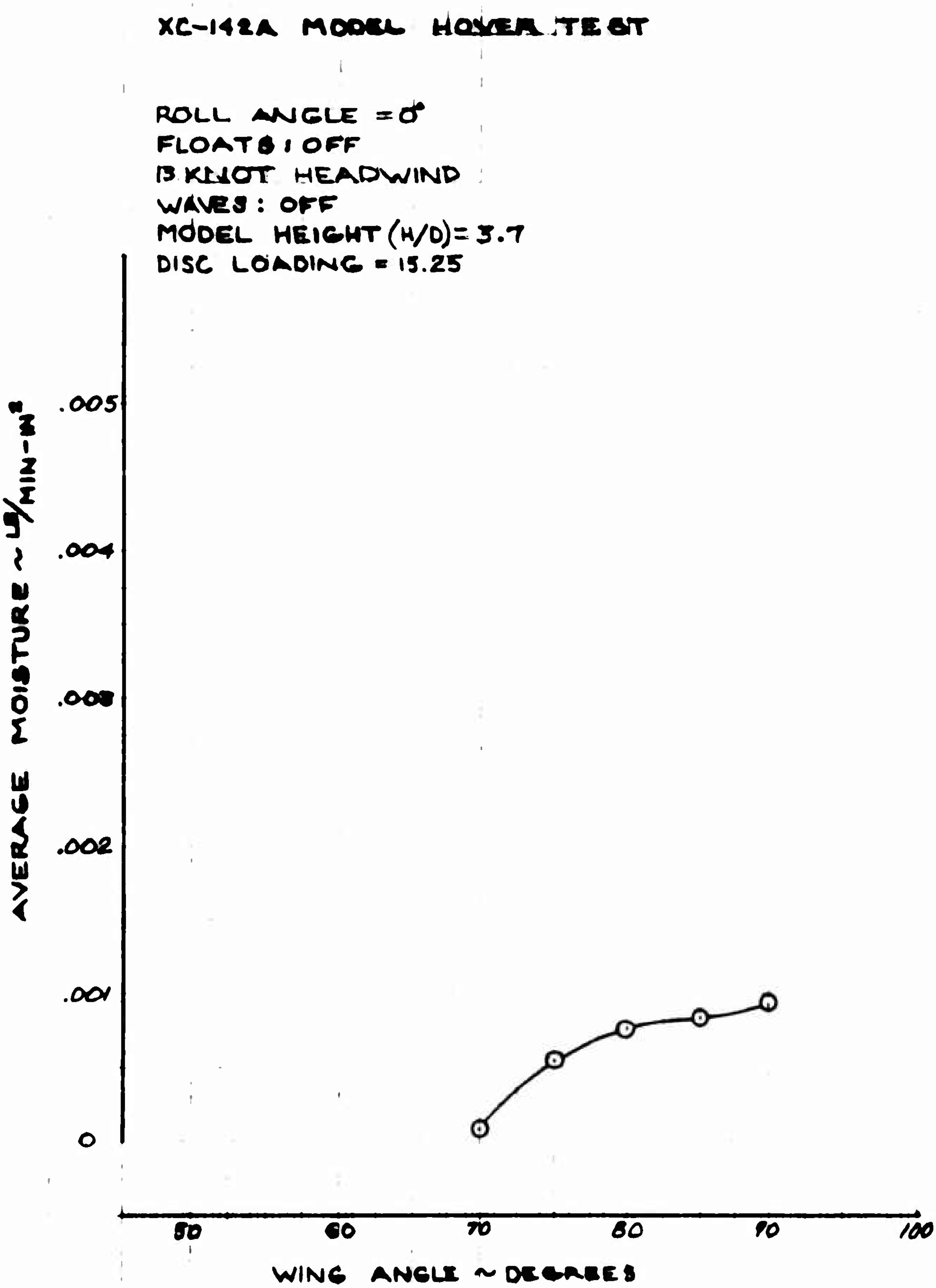


Figure 4-36 Water Entering Propellers - Effects of Wing Angle

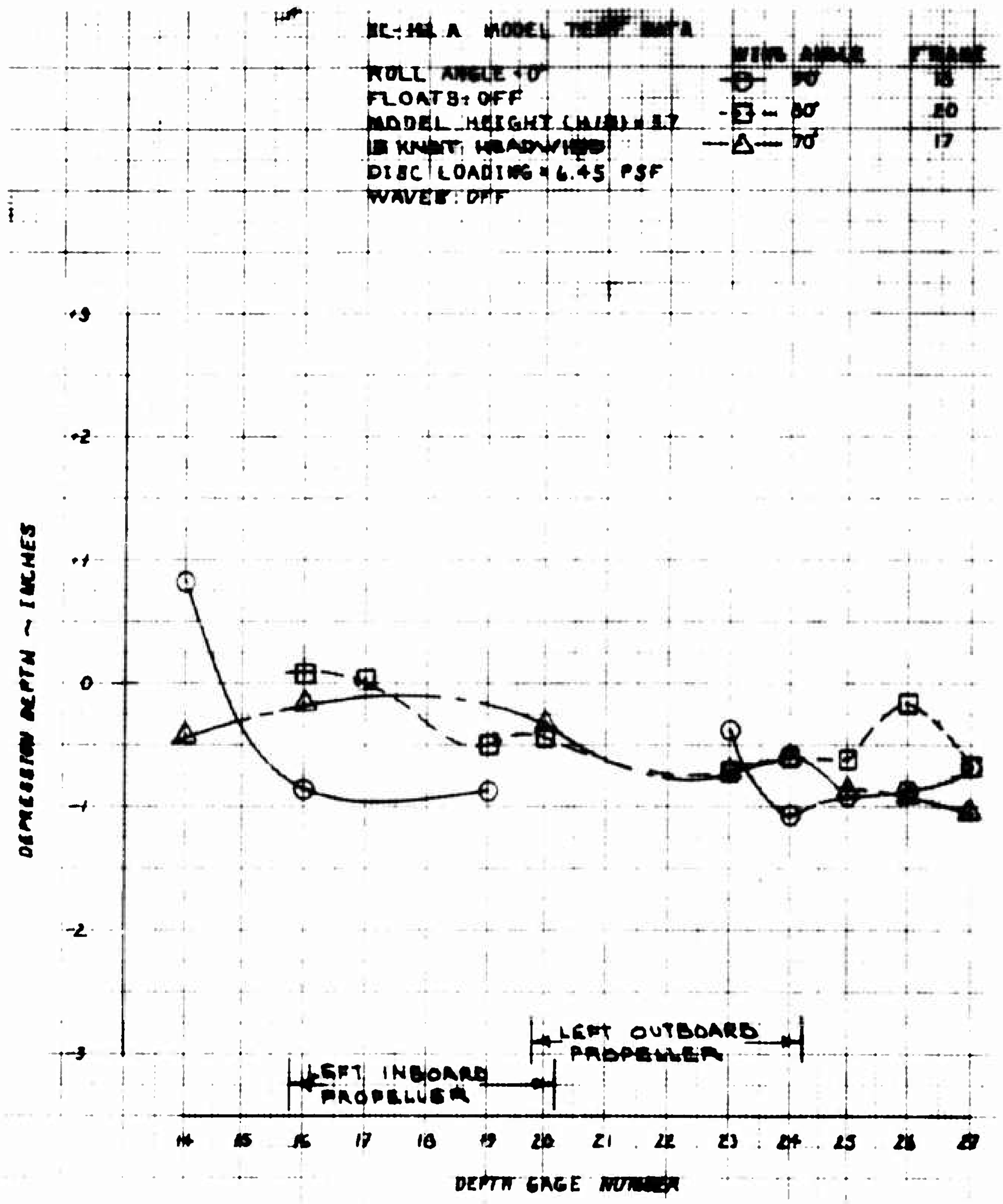


Figure 4-37 Water Displacement Along Propeller Centerline - Effects of Wing Angle

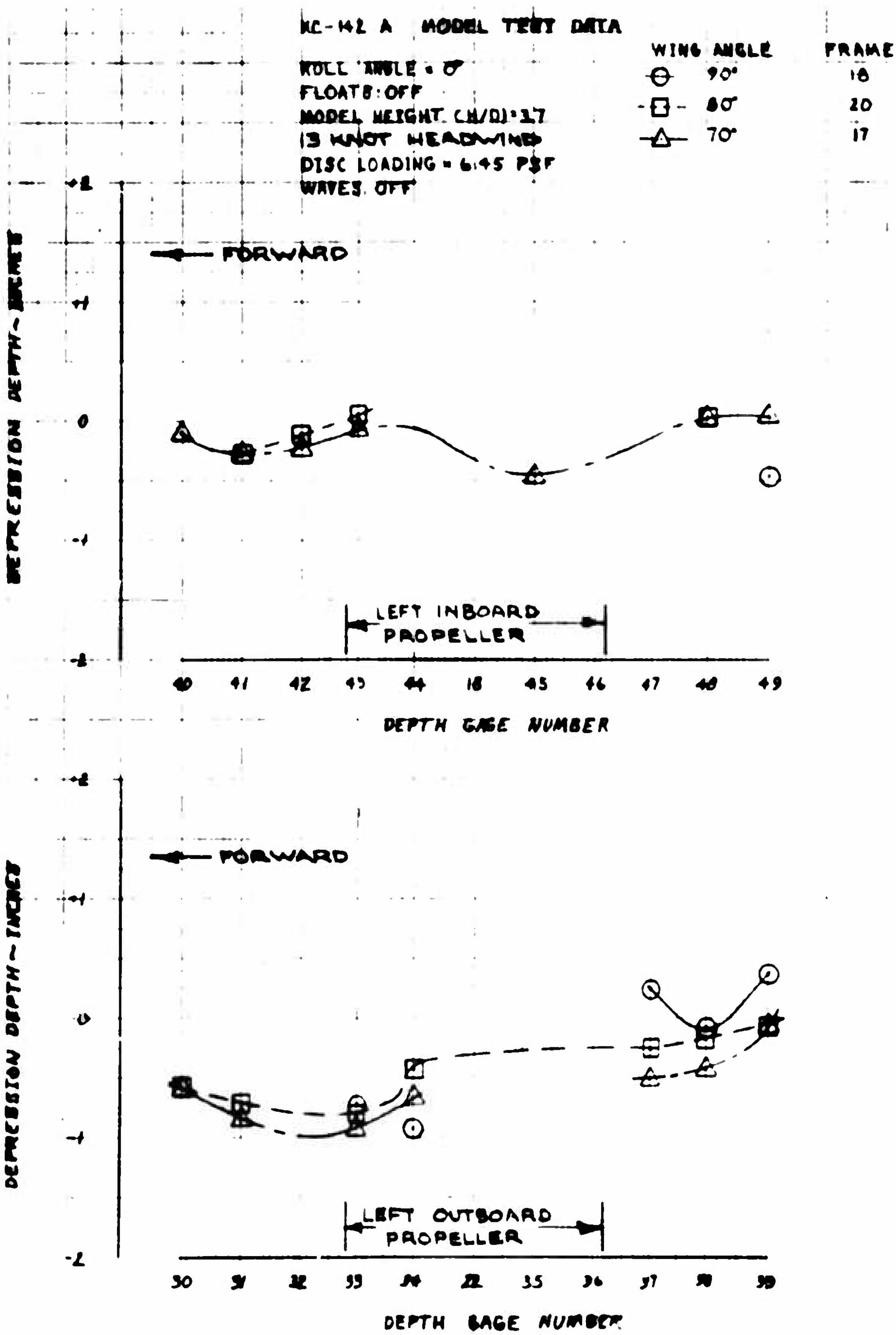


Figure 4-38 Water Displacement Fore and Aft - Effects of Wing Angle

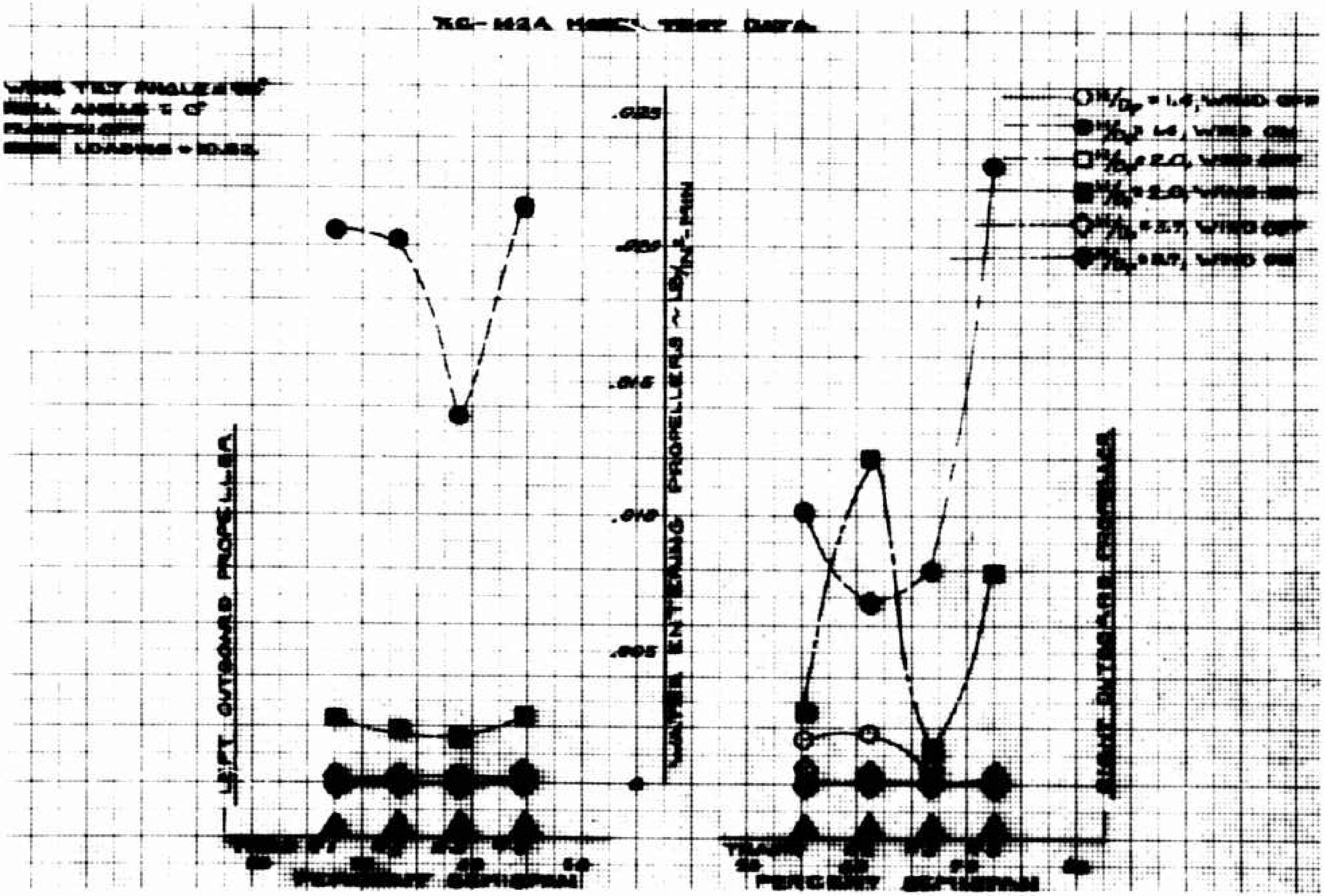


Figure 4-39 Water Entering Propellers - Effects of Surface Winds

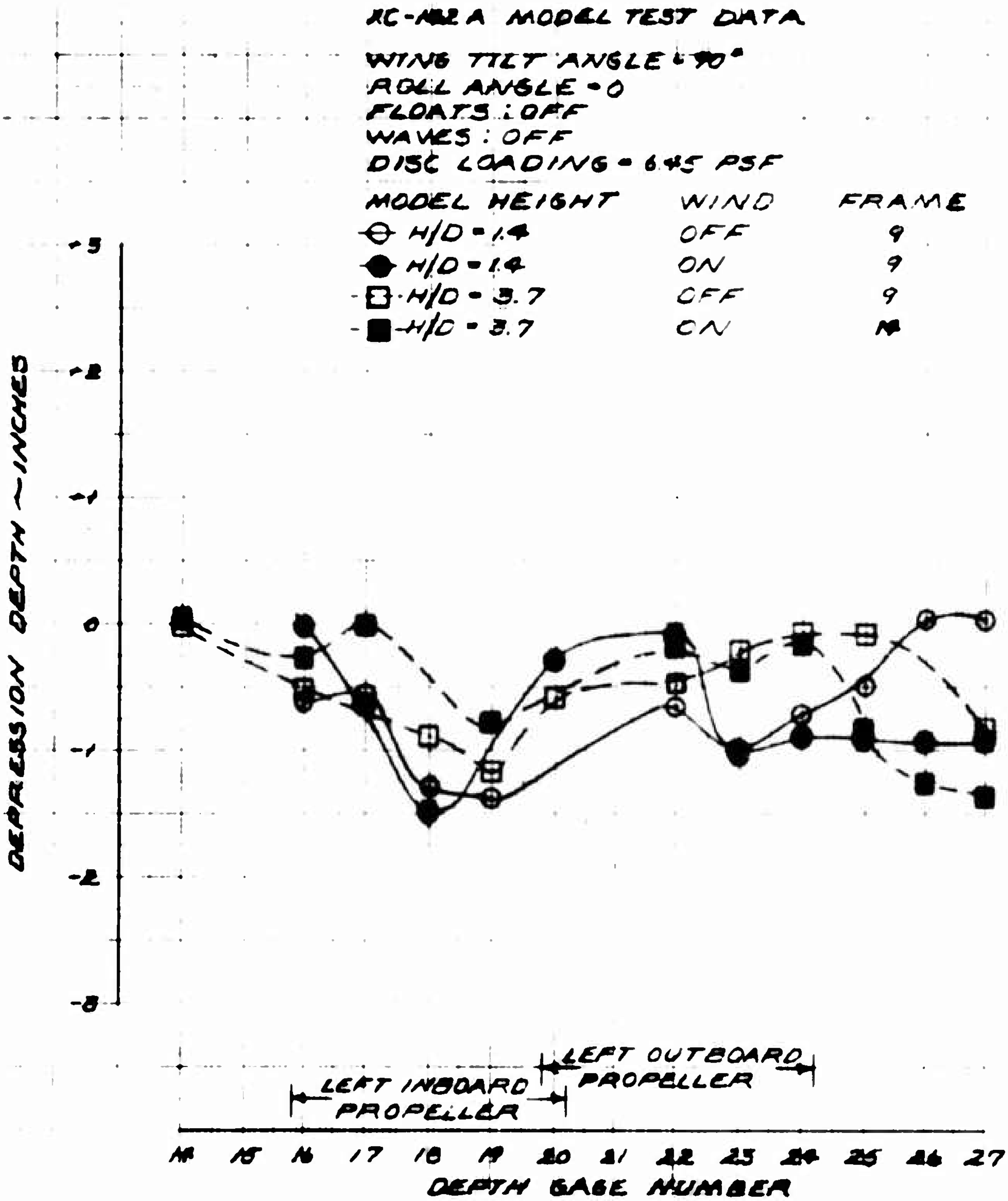


Figure 4-40 Water Displacement Along Propeller Centerline - Effects of Wind

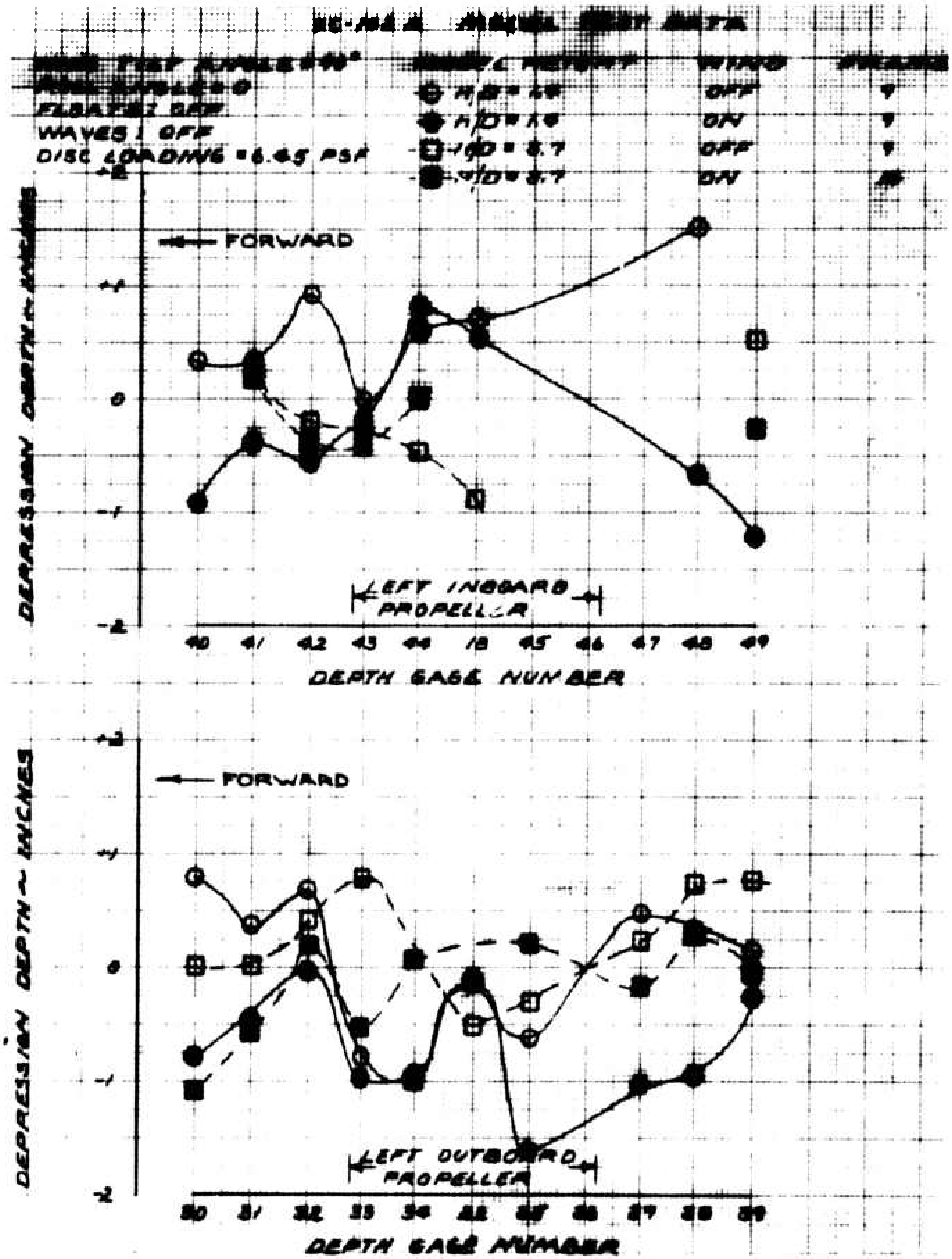


Figure 4-41 Water Displacement Fore and Aft - Effects of Wind

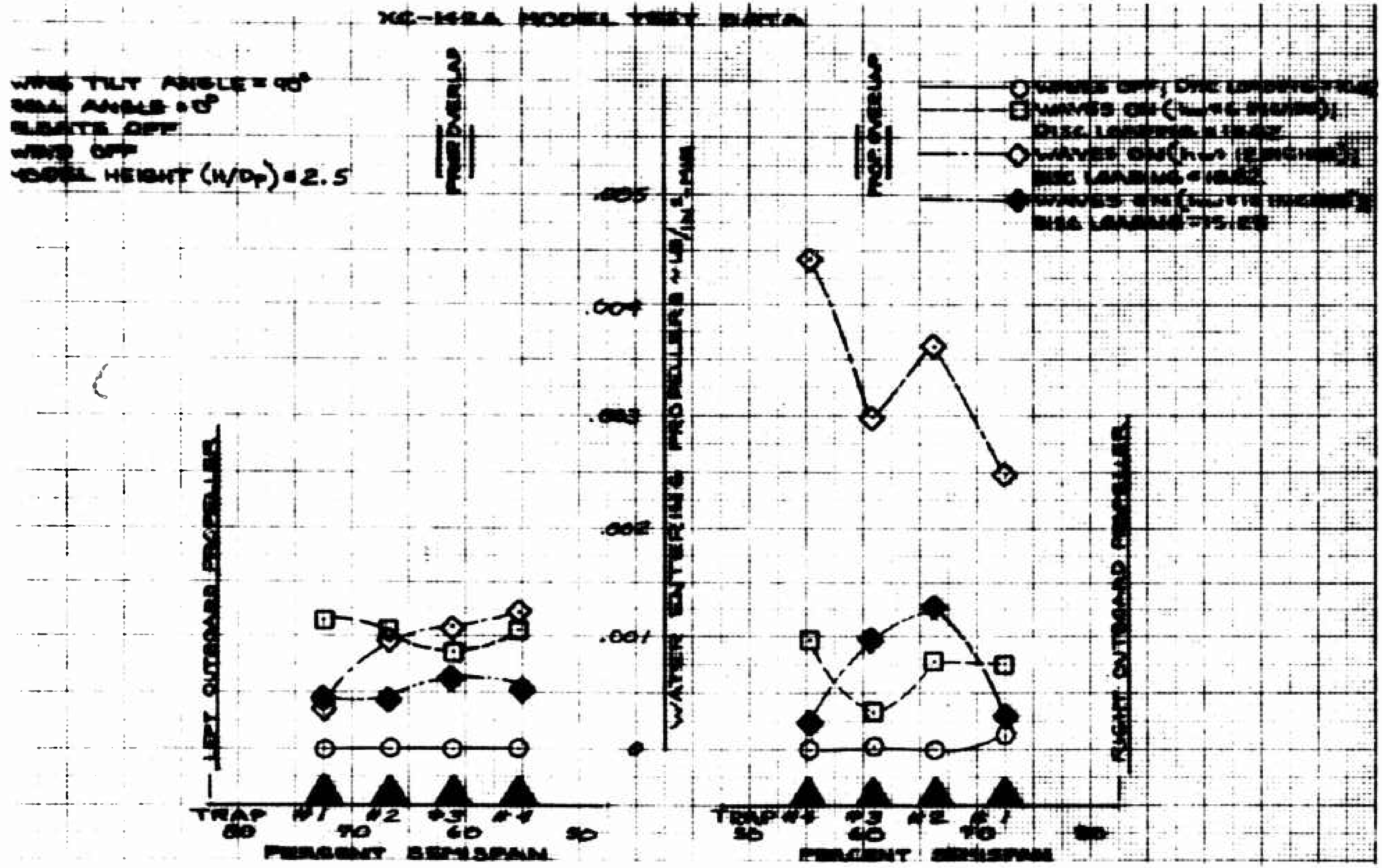


Figure 4-42 Water Entering Propellers — Effects of Wave Height

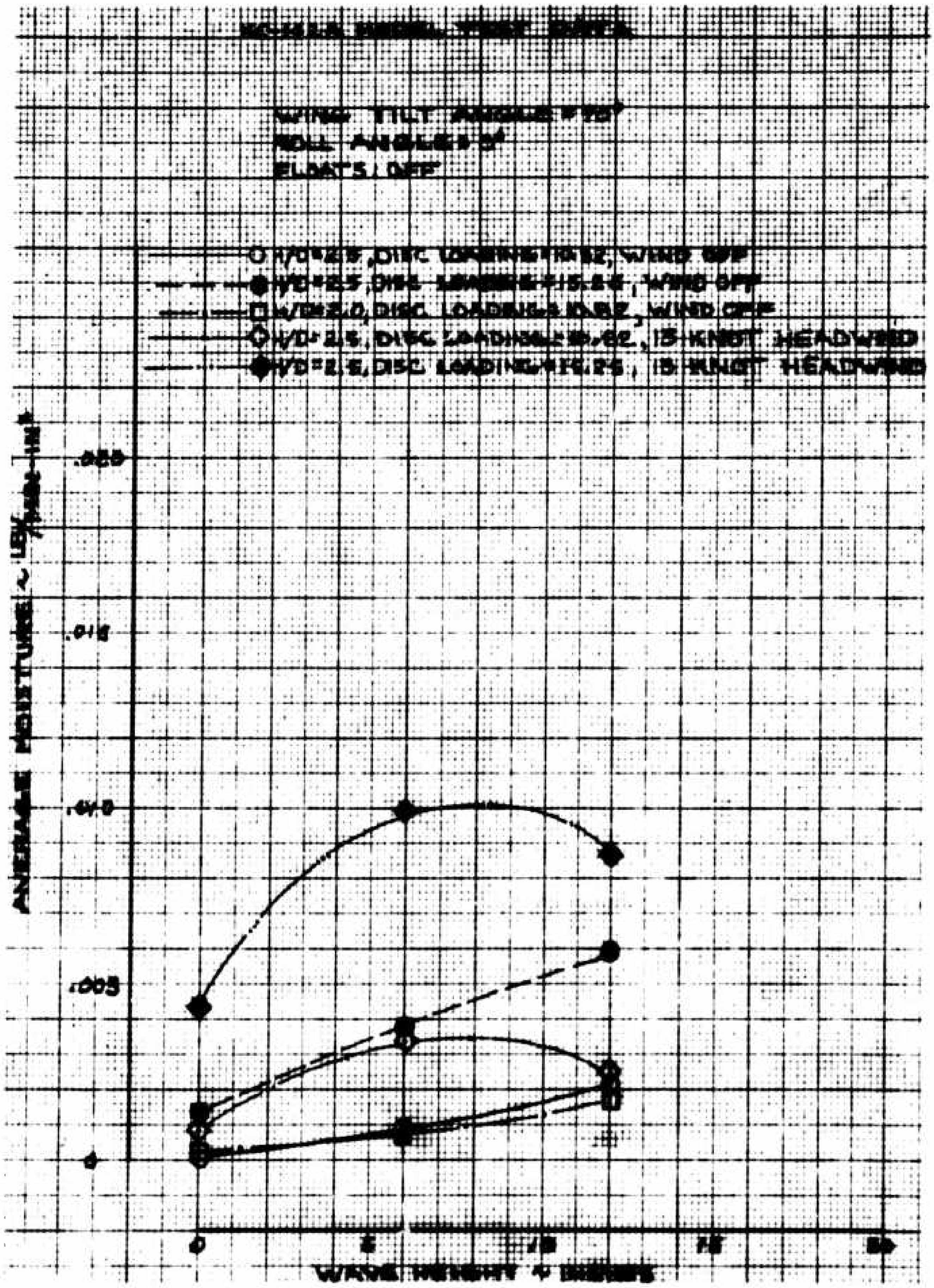


Figure 4-43 Water Entering Propellers - Effects of Wave Height

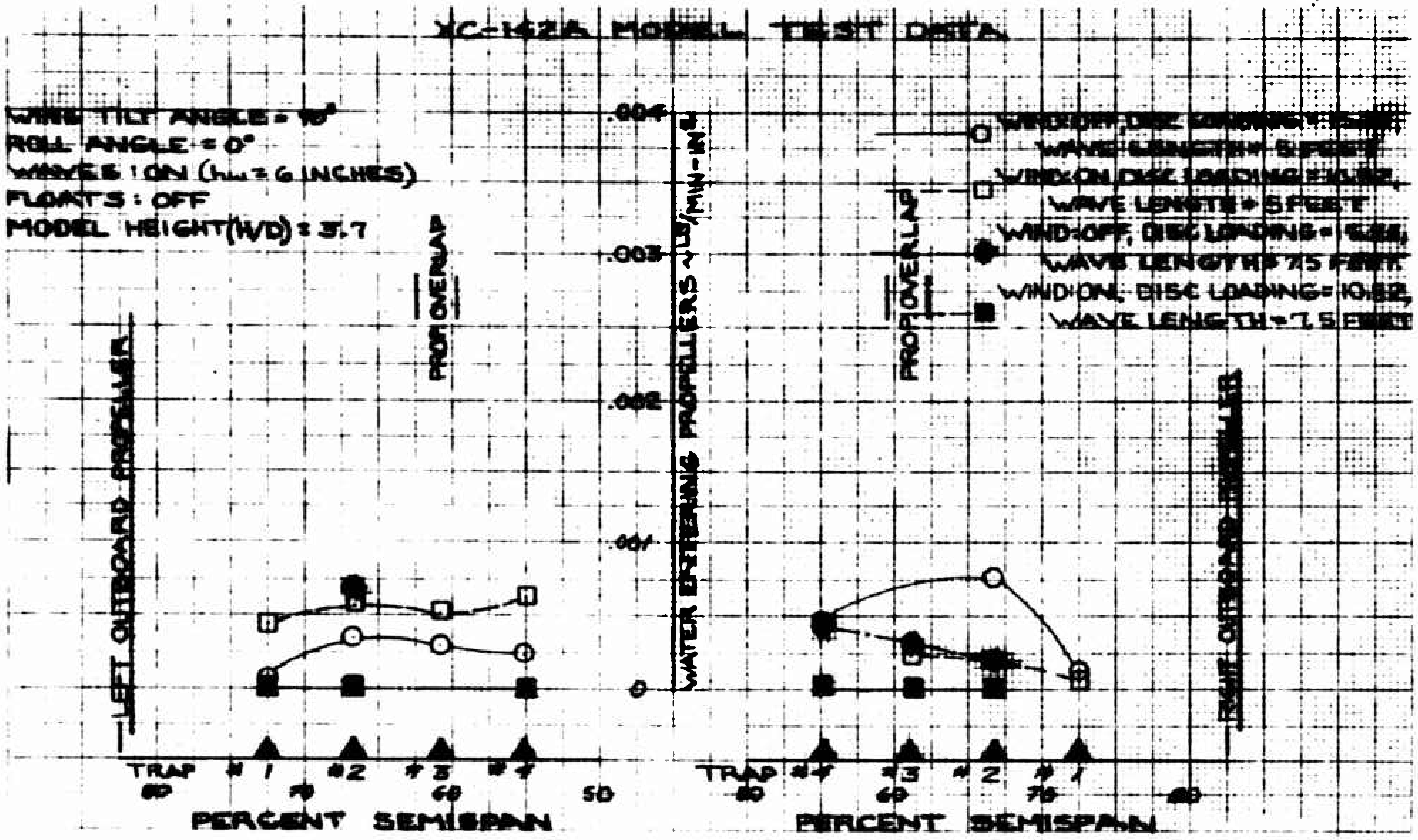


Figure 4-44 Water Entering Propellers - Effects of Wave Length

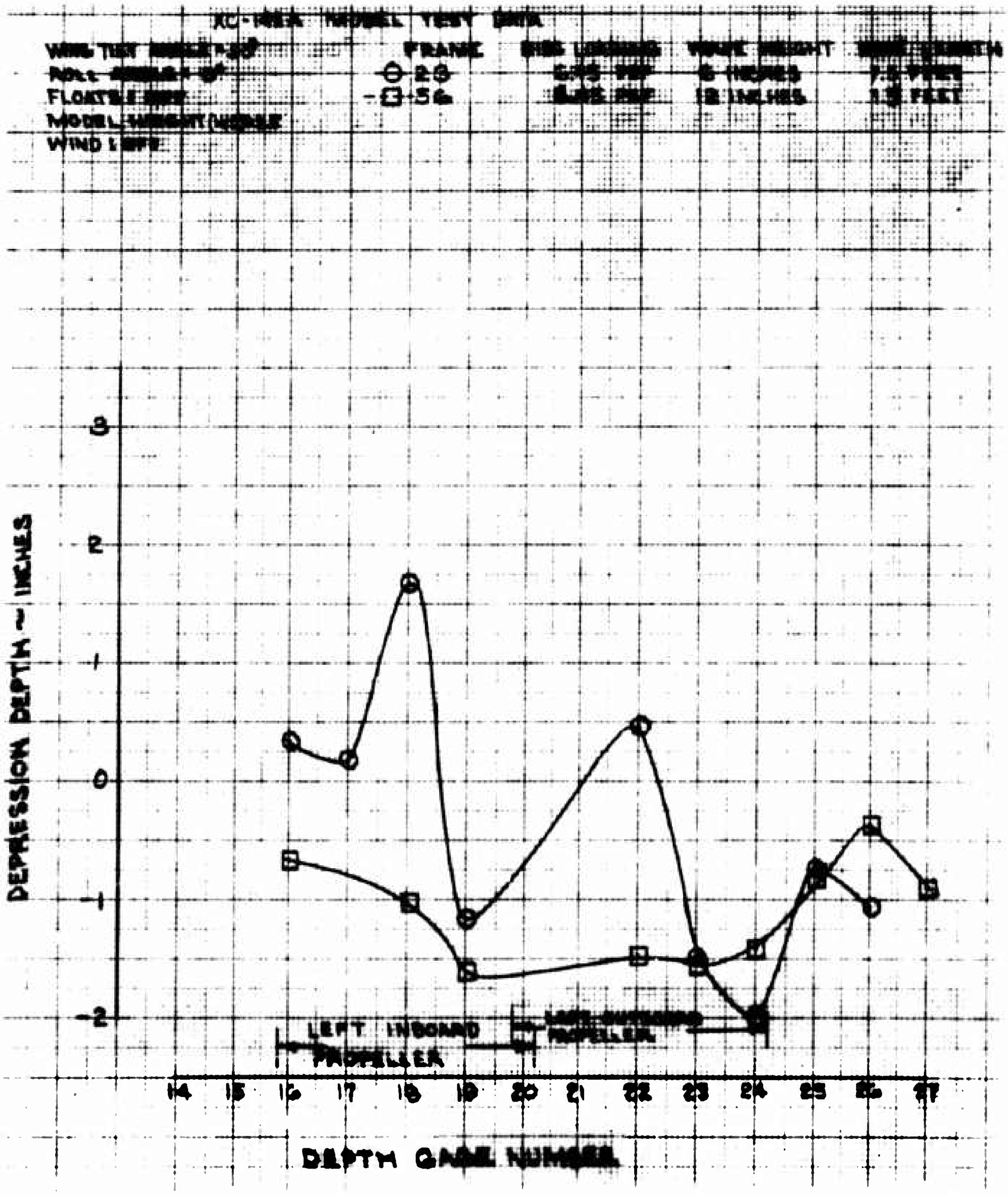


Figure 4-45 Water Displacement Along Propeller Centerline -- Effects of Waves

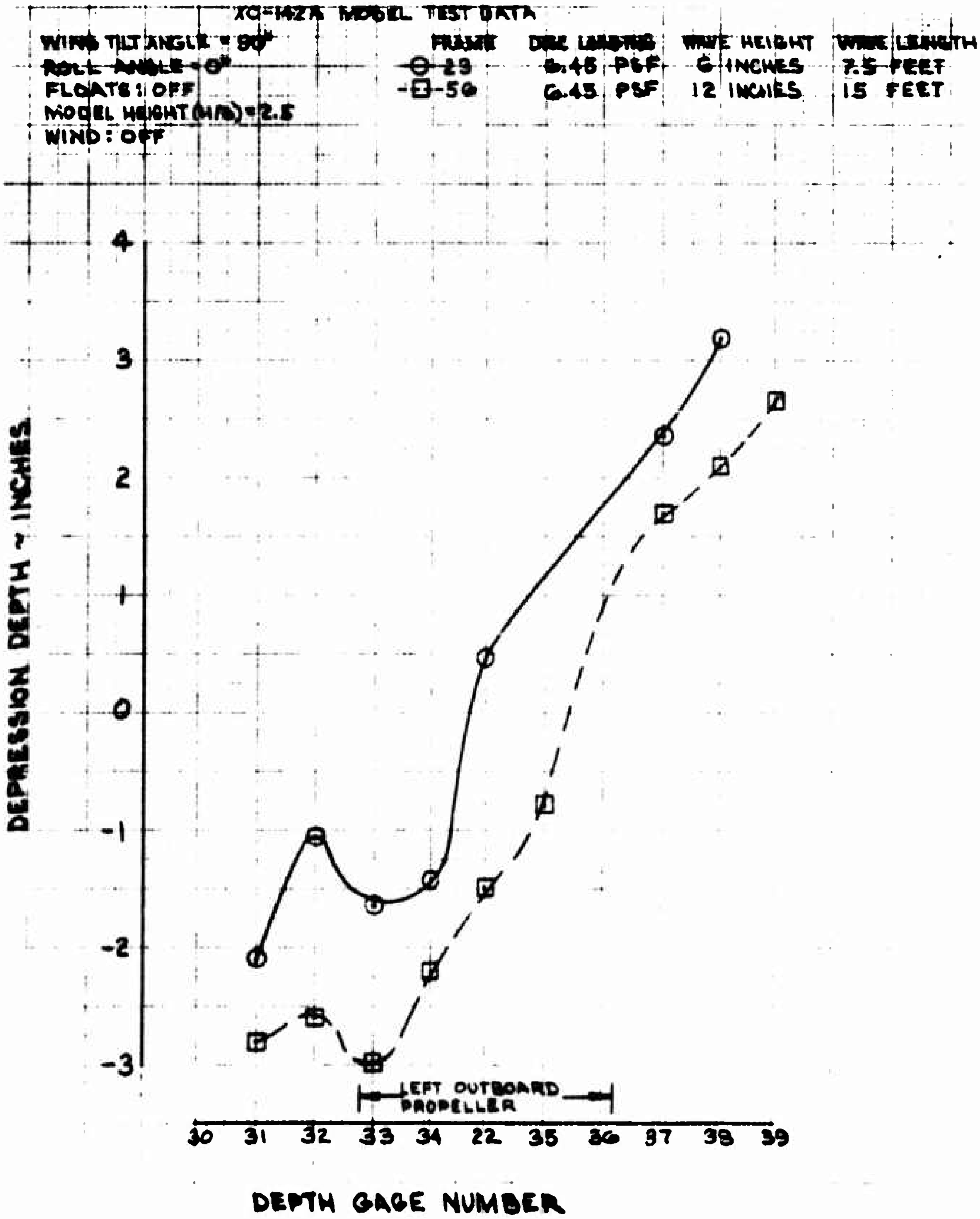


Figure 4-46 Water Displacement Along Propeller Centerline - Effects of Waves

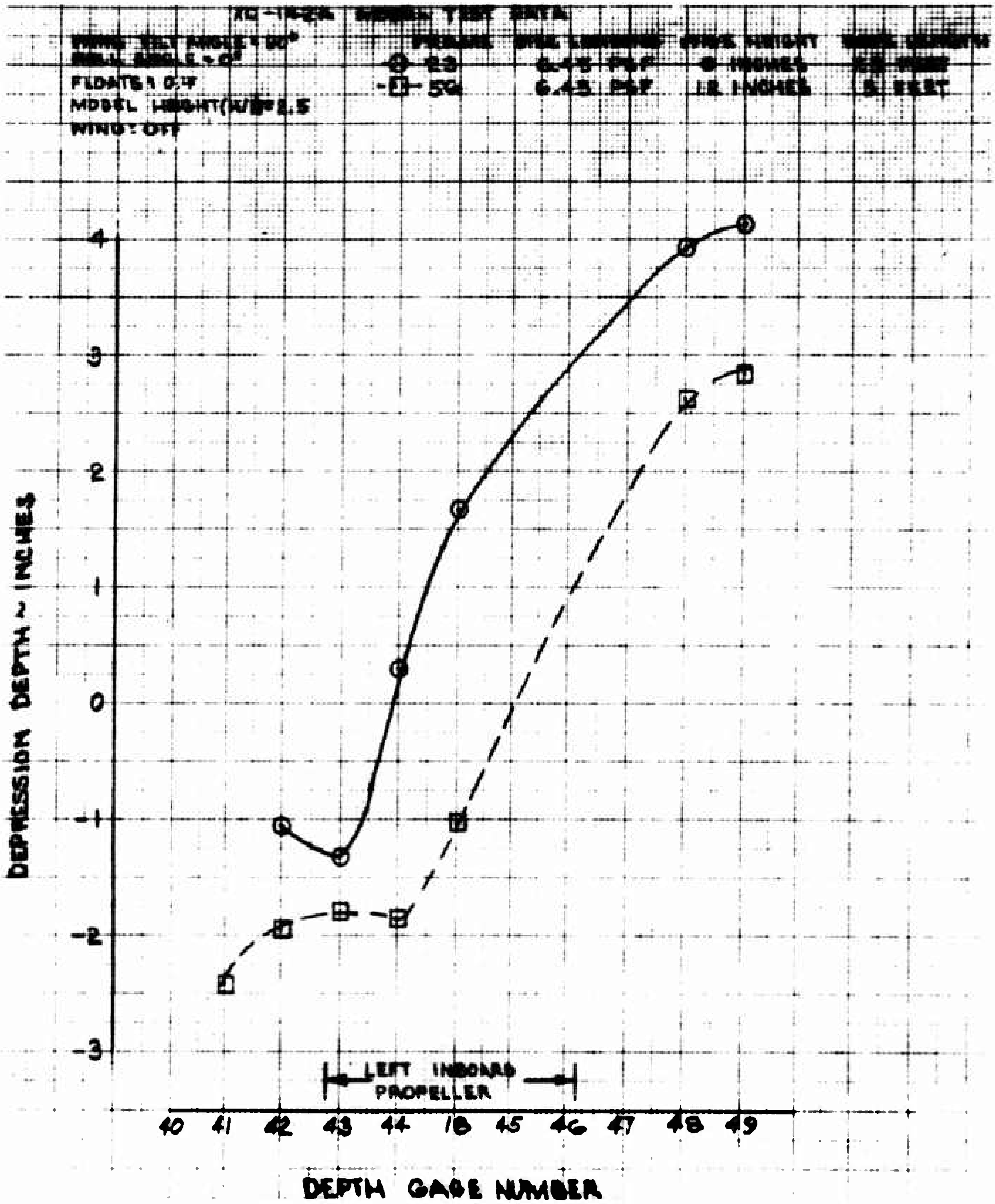


Figure 4-47 Water Displacement Along Propeller Centerline - Effects of Waves

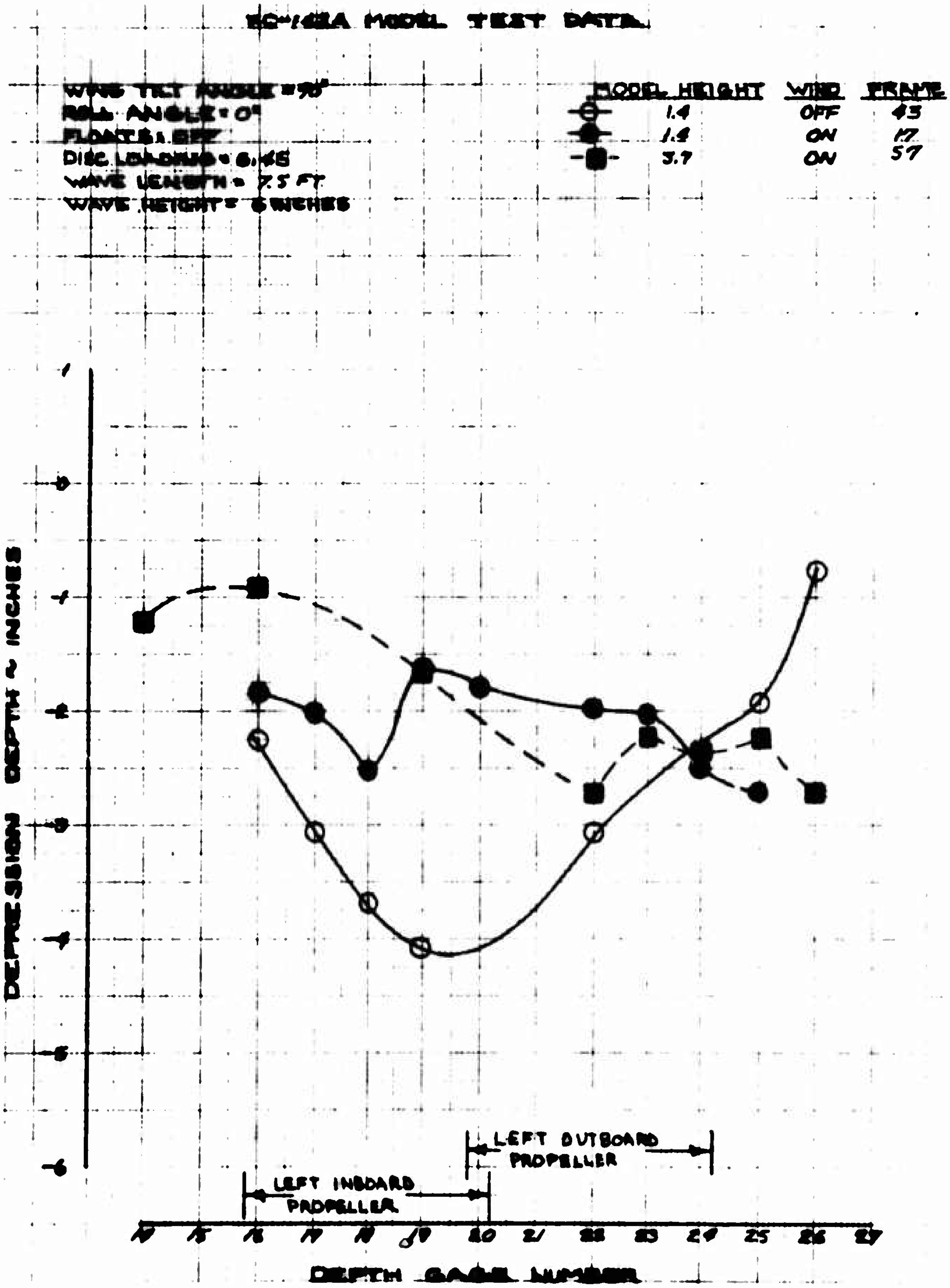


Figure 4-48 Water Displacement Along Propeller Centerline - Effects of Waves

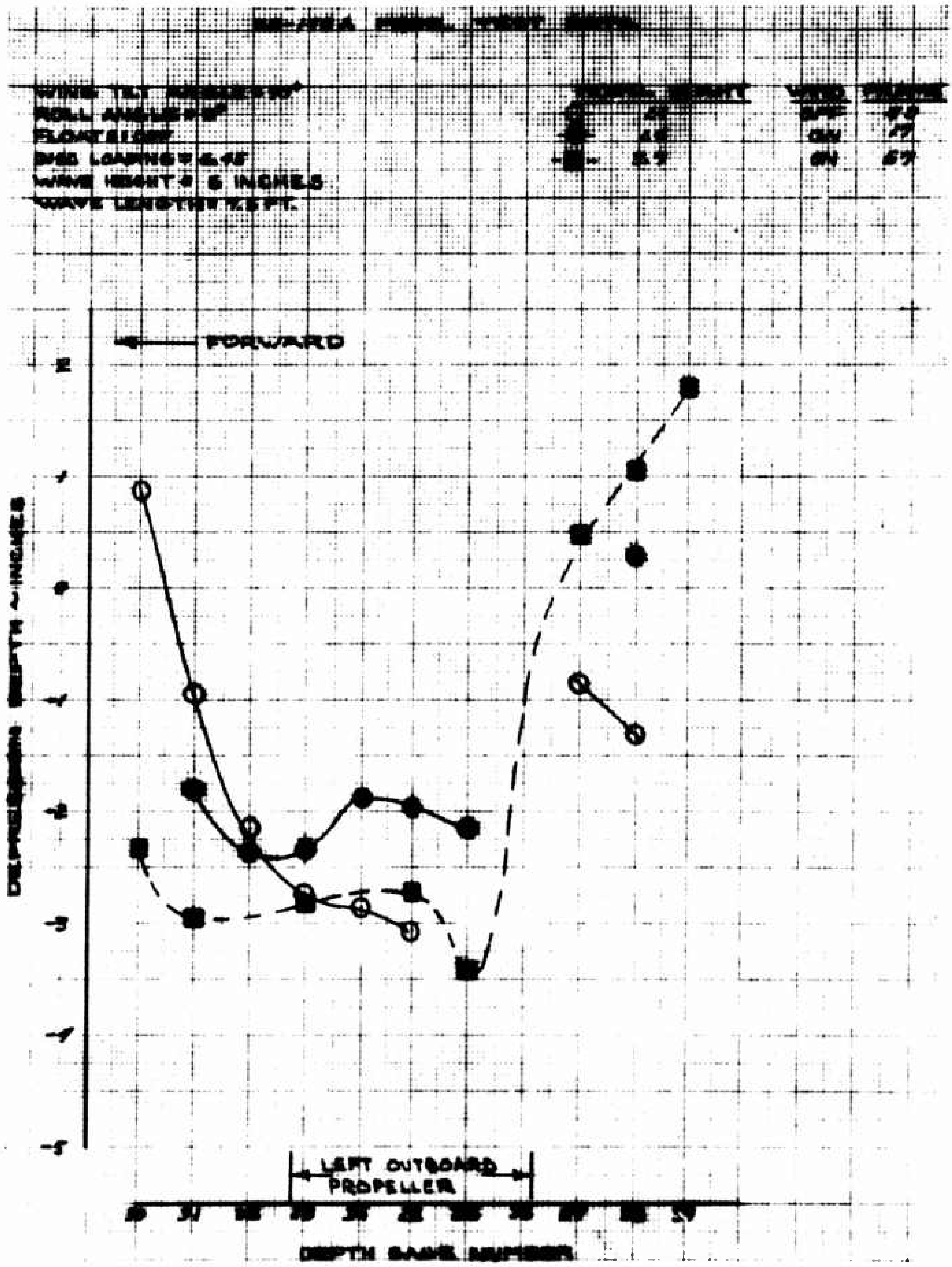


Figure 4-49 Water Displacement Fore and Aft — Effects of Waves

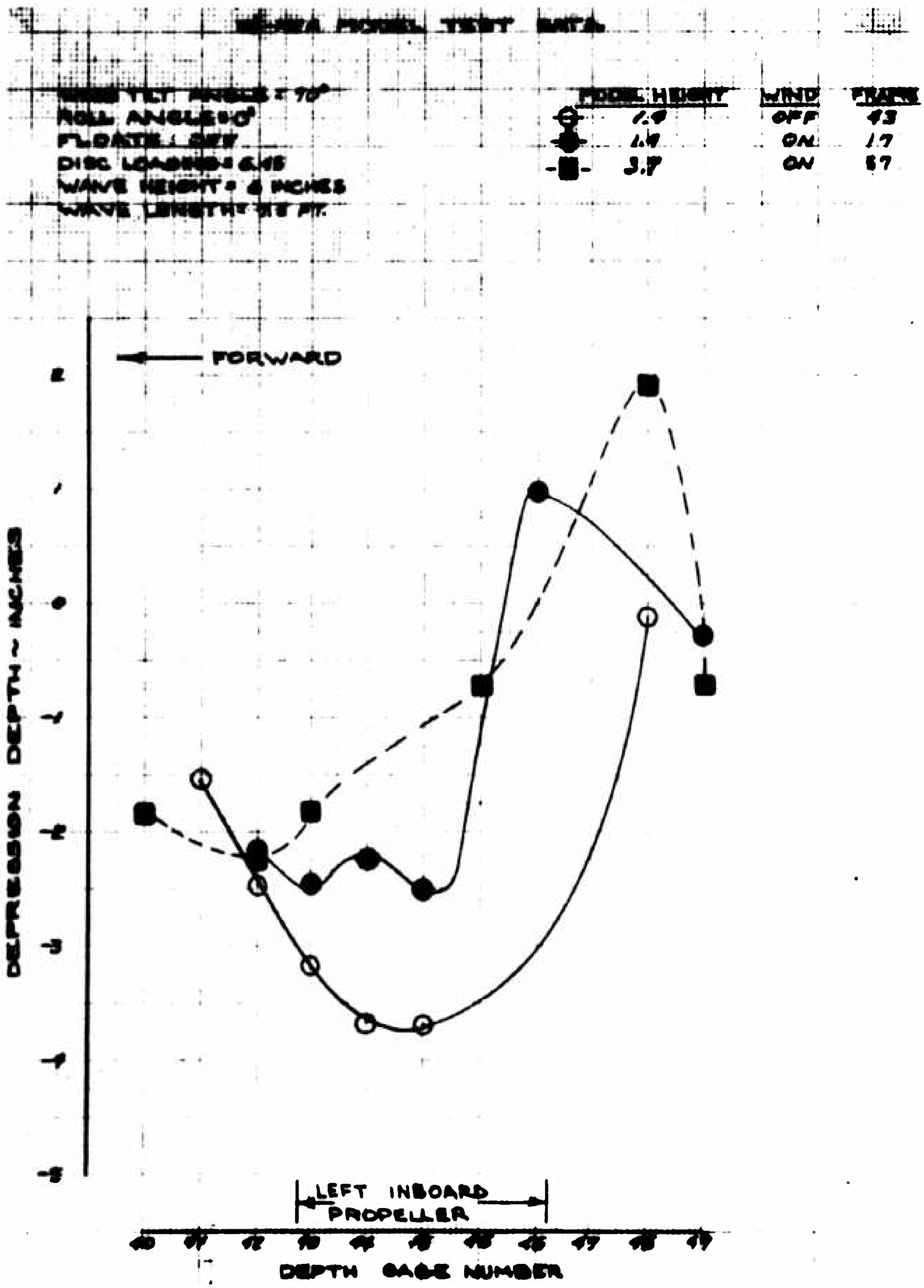


Figure 4-50 Water Displacement Fore and Aft — Effects of Waves

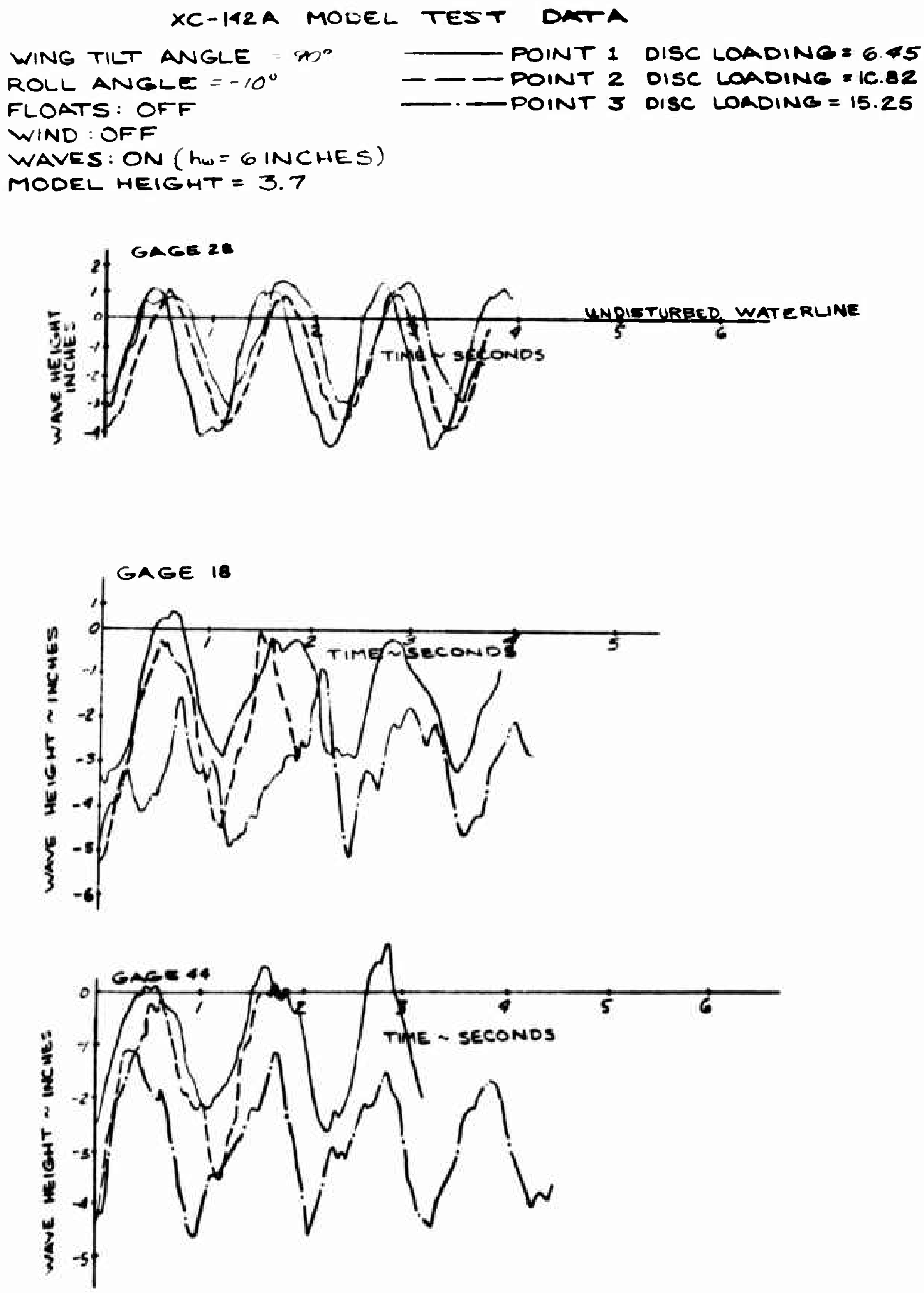


Figure 4-51 Effects of Waves

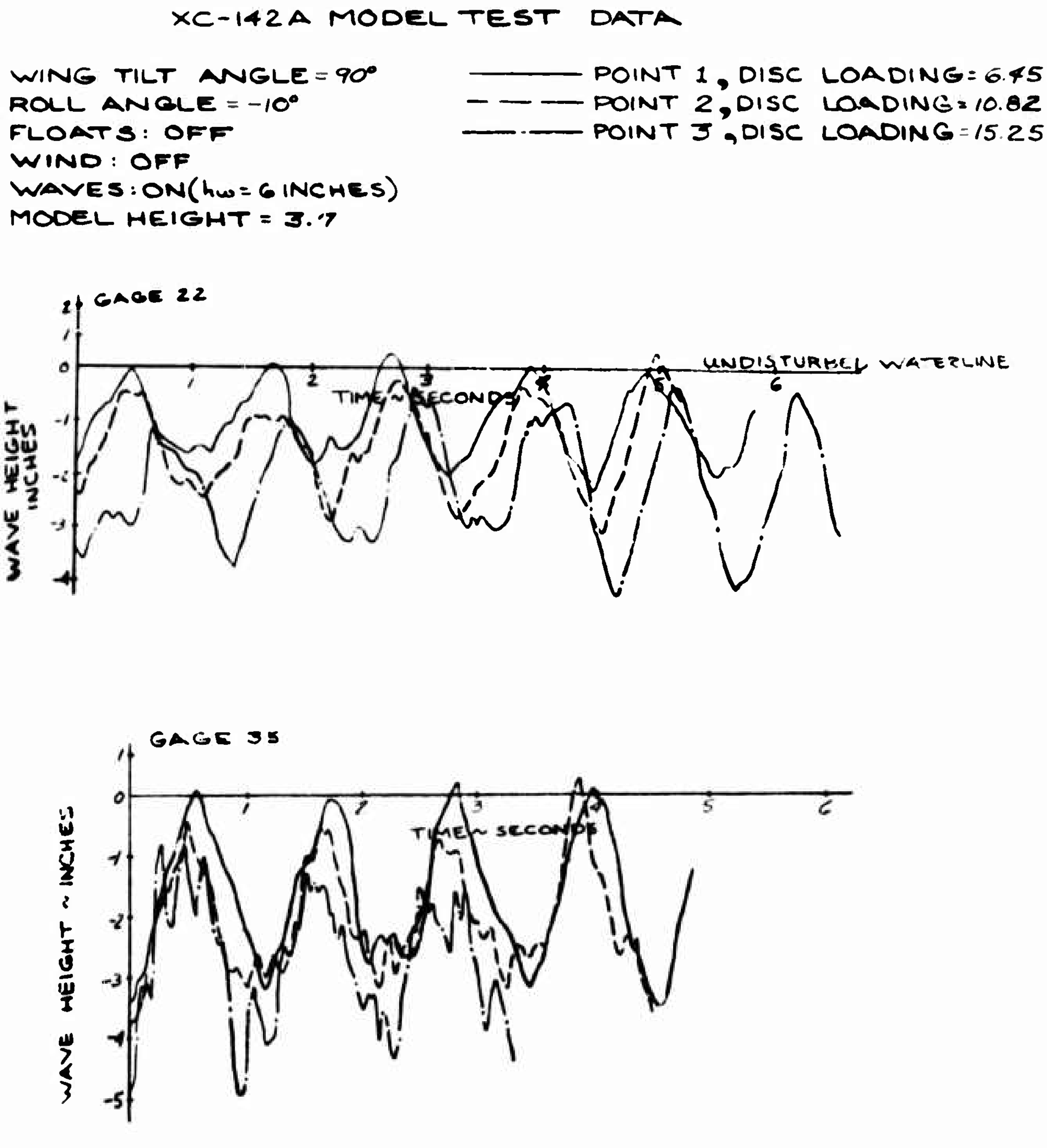


Figure 4-52 Effects of Waves

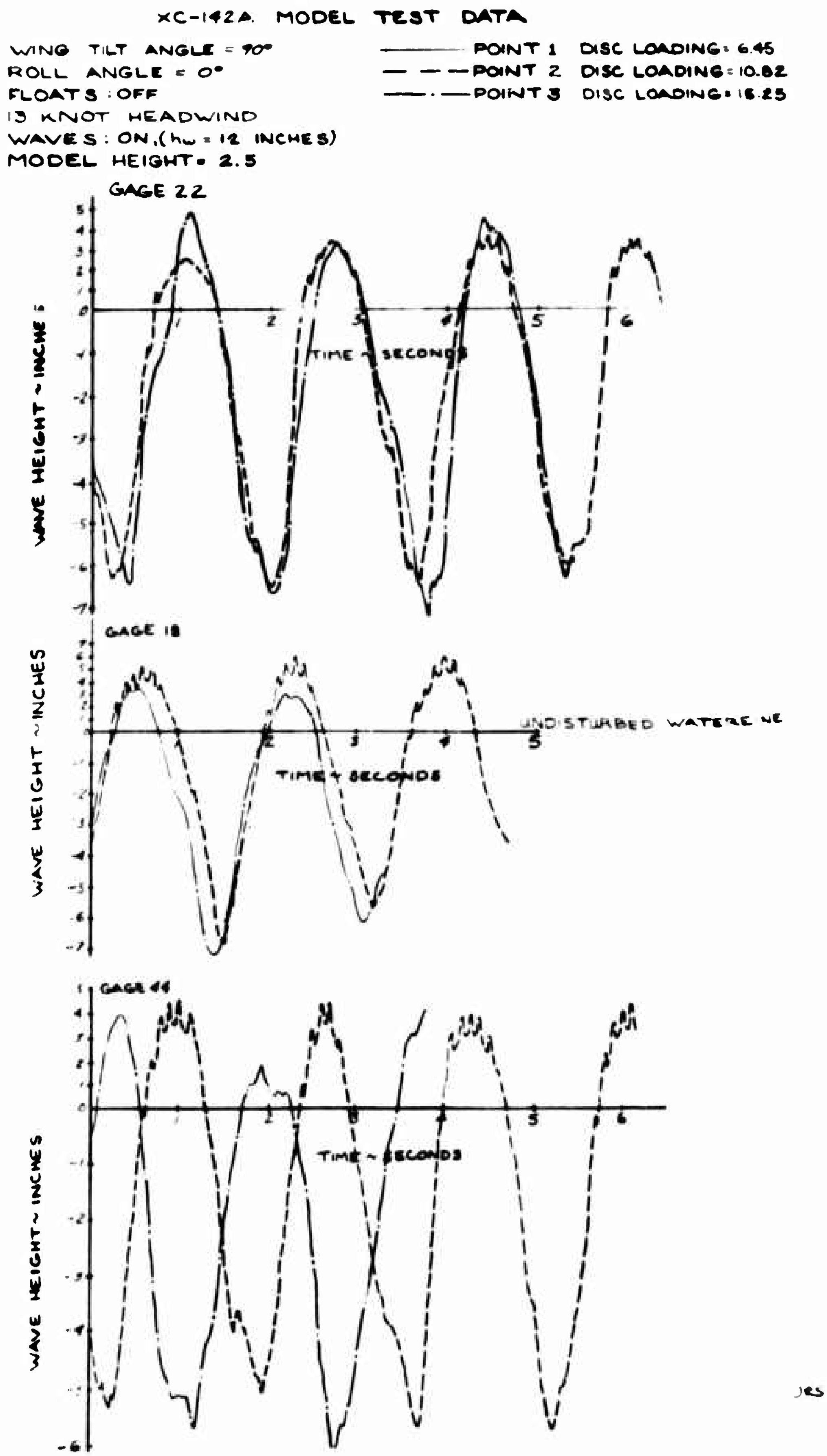


Figure 4-53 Effects of Waves

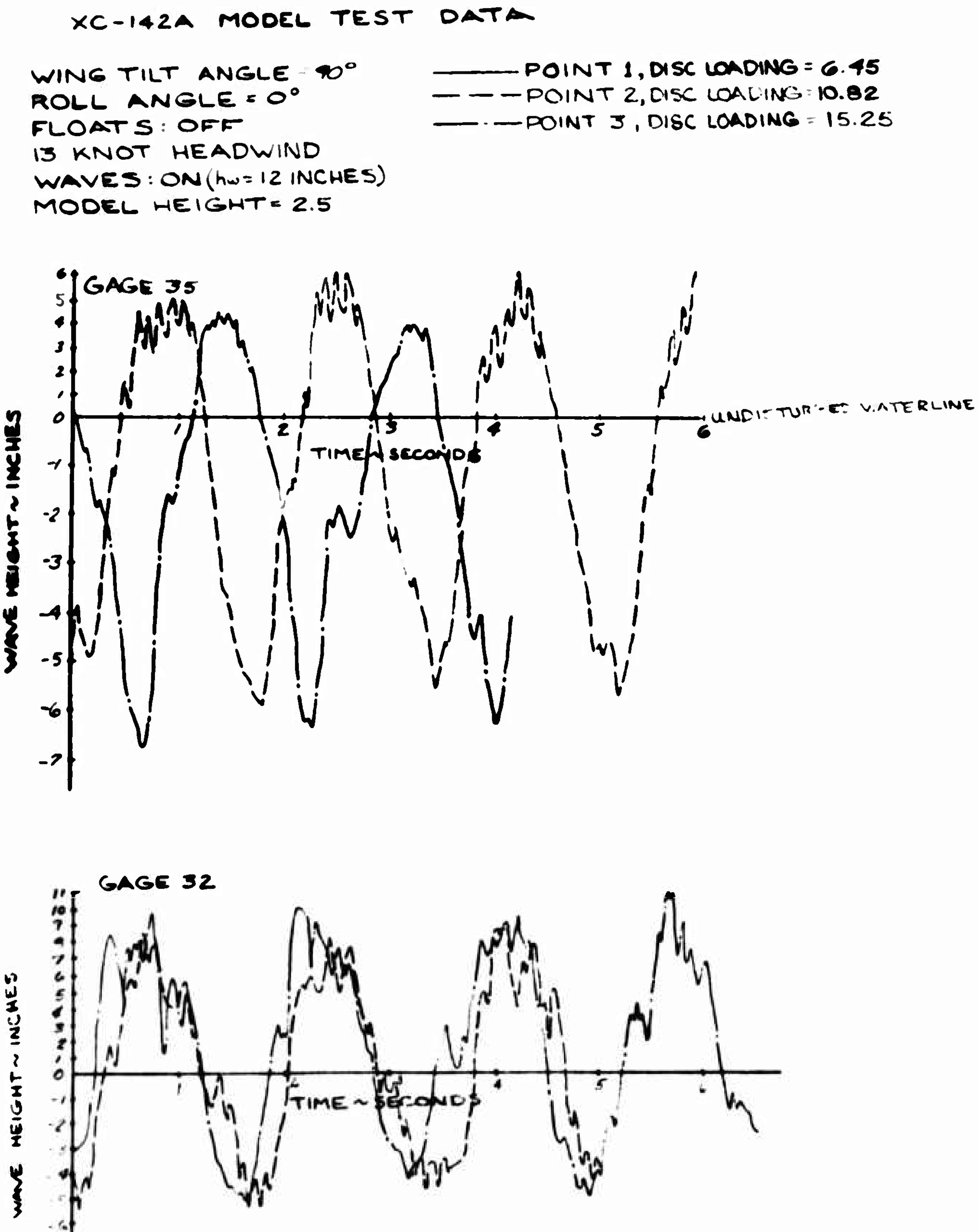


Figure 4-54 Effects of Waves

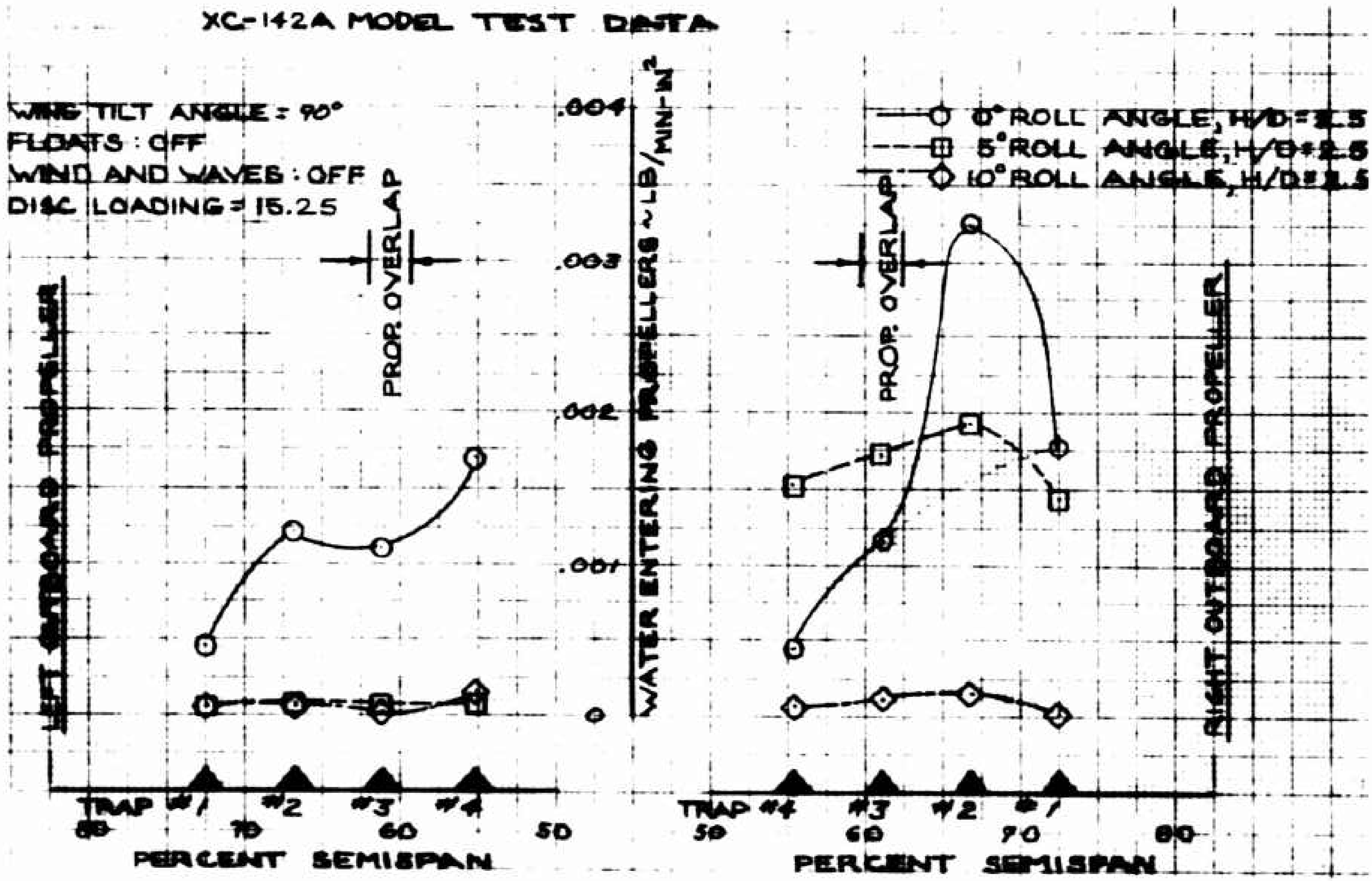


Figure 4-55 Water Entering Propellers - Effects of Roll Angle

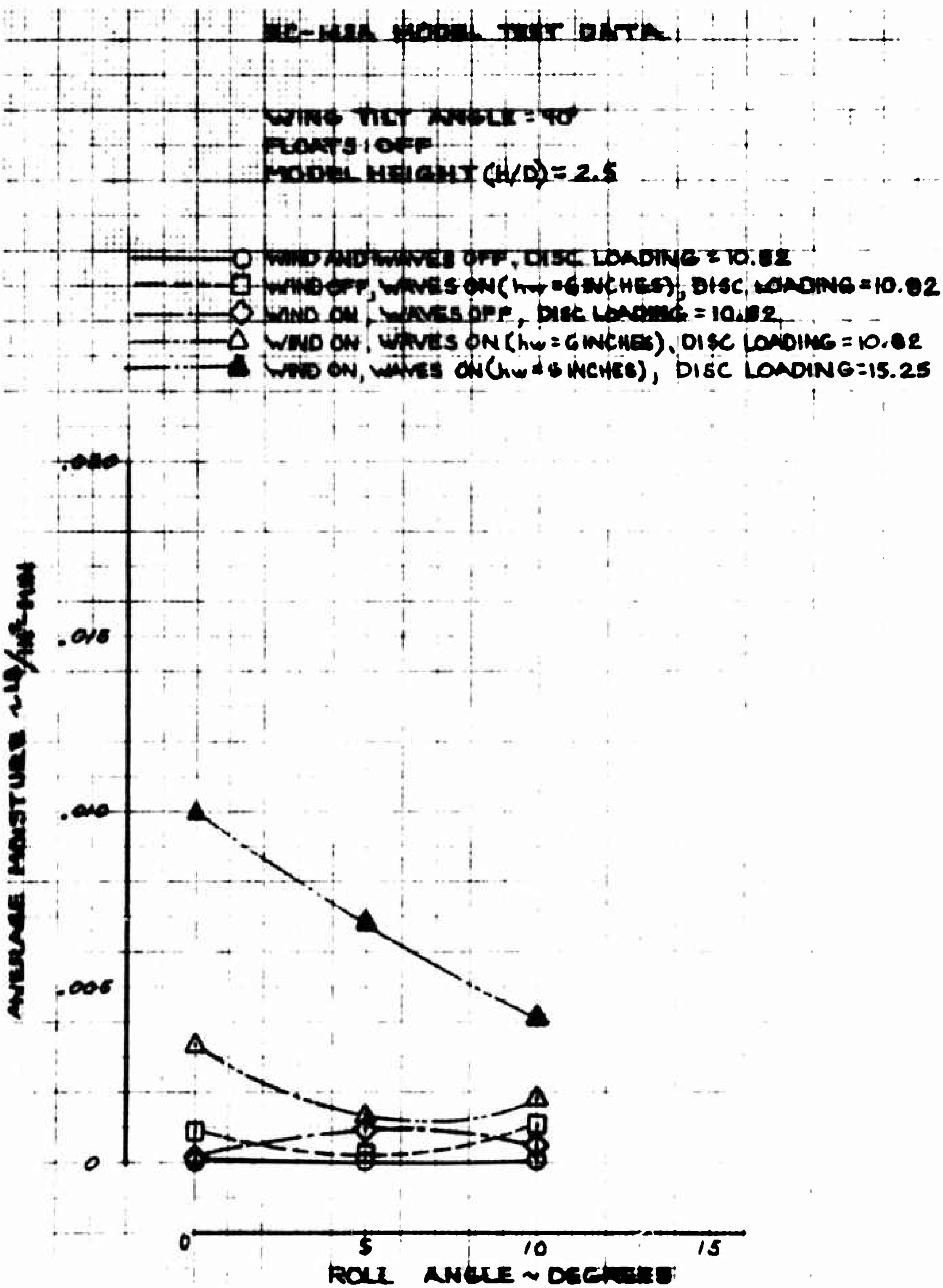


Figure 4-56 Water Entering Propellers - Effects of Roll Angle

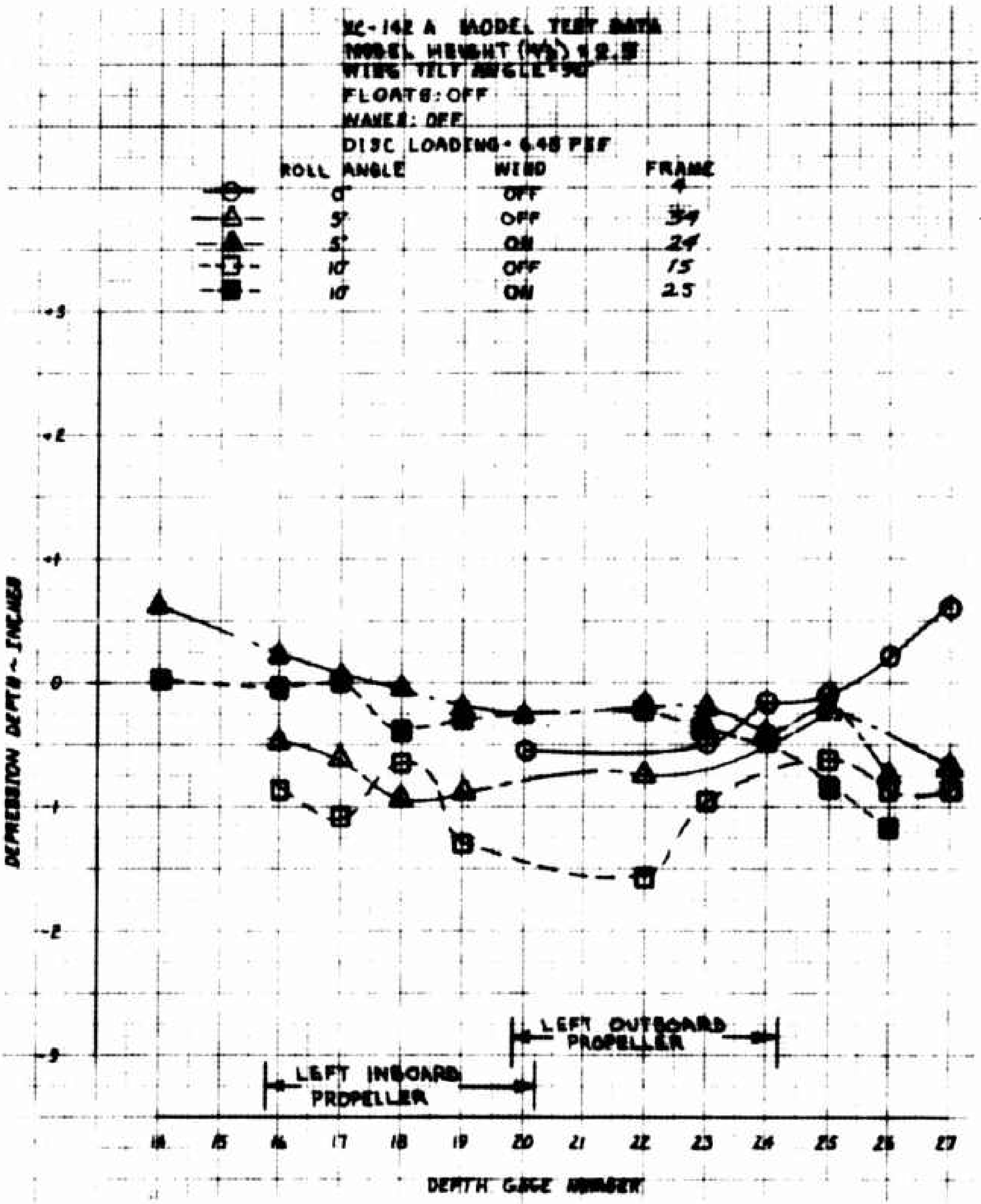


Figure 4-57 Water Displacement Along Propeller Centerline - Effects of Roll Angle

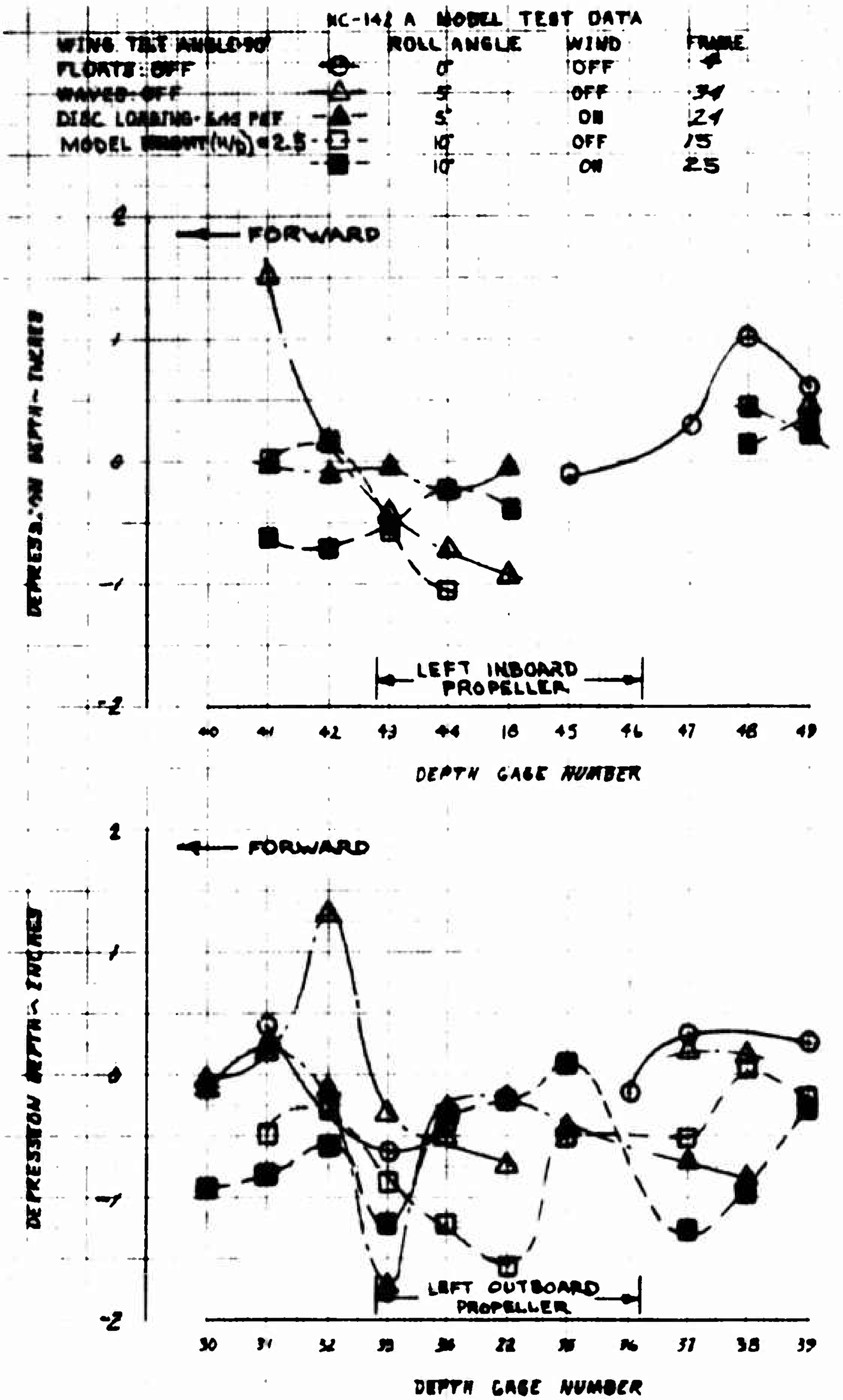


Figure 4-58 Water Displacement Fore and Aft – Effects of Roll Angle

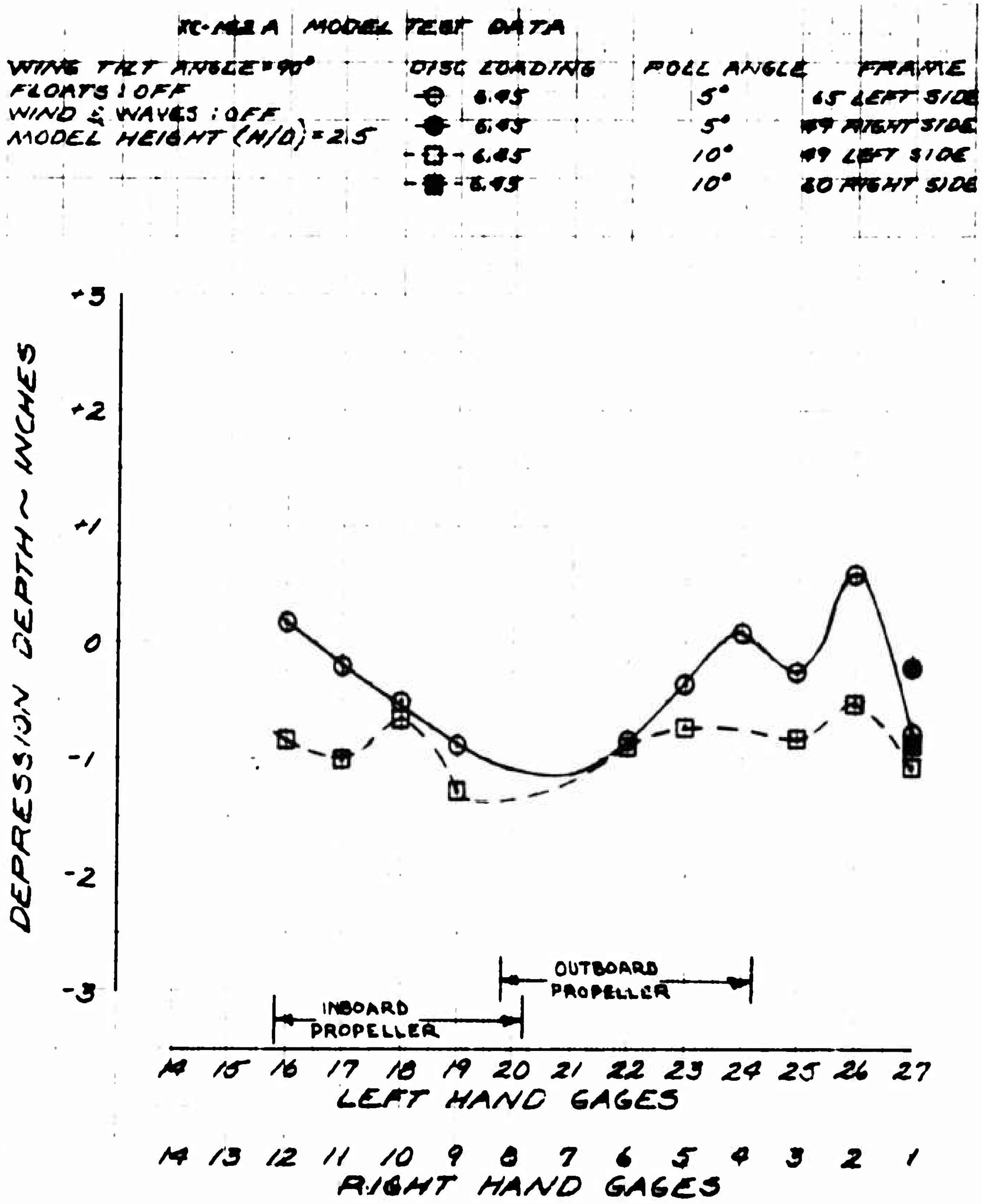


Figure 4-59 Water Displacement Along Propeller Centerline – Effects of Roll Angle

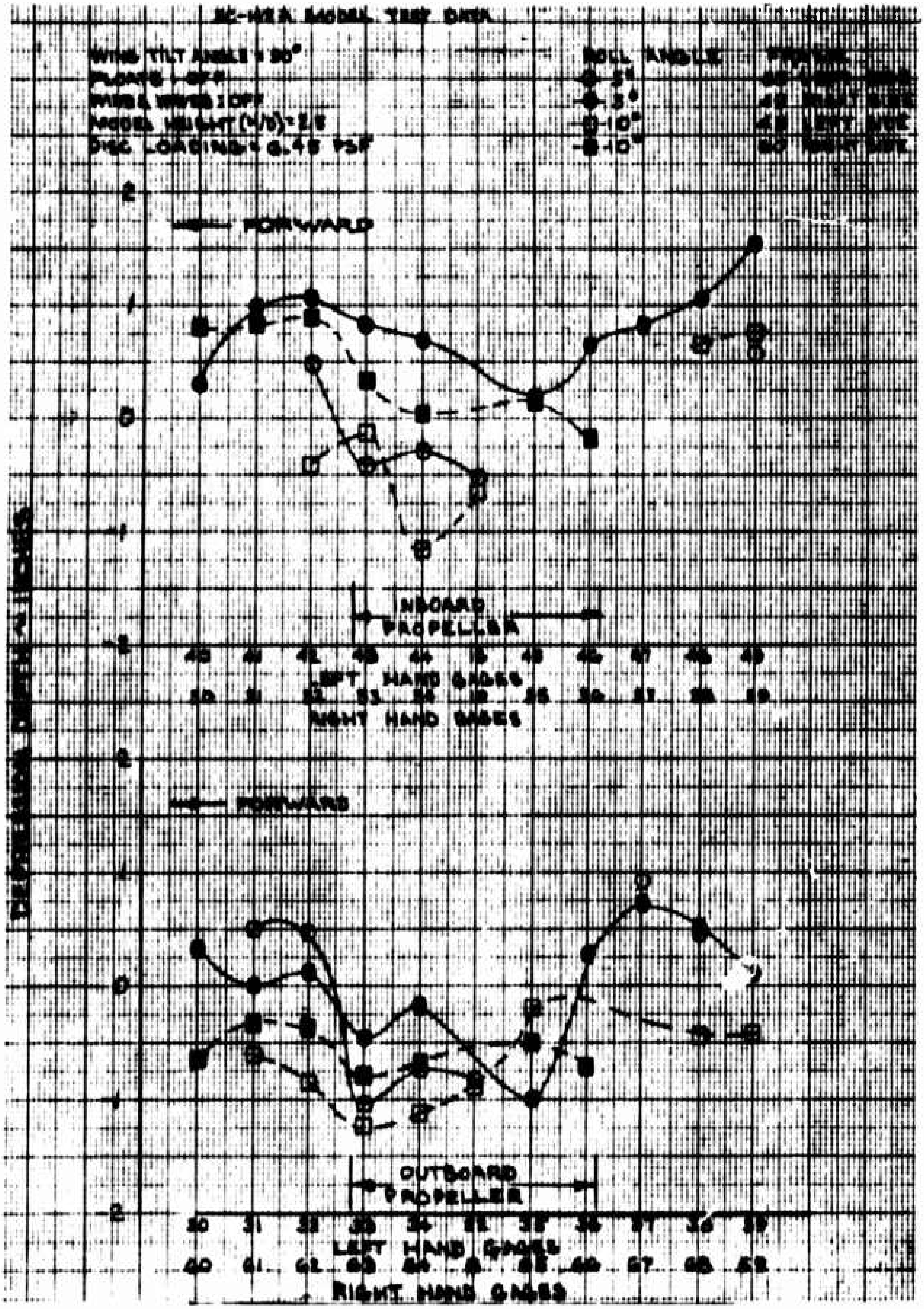


Figure 4-60 Water Displacement Fore and Aft -- Effects of Roll Angle

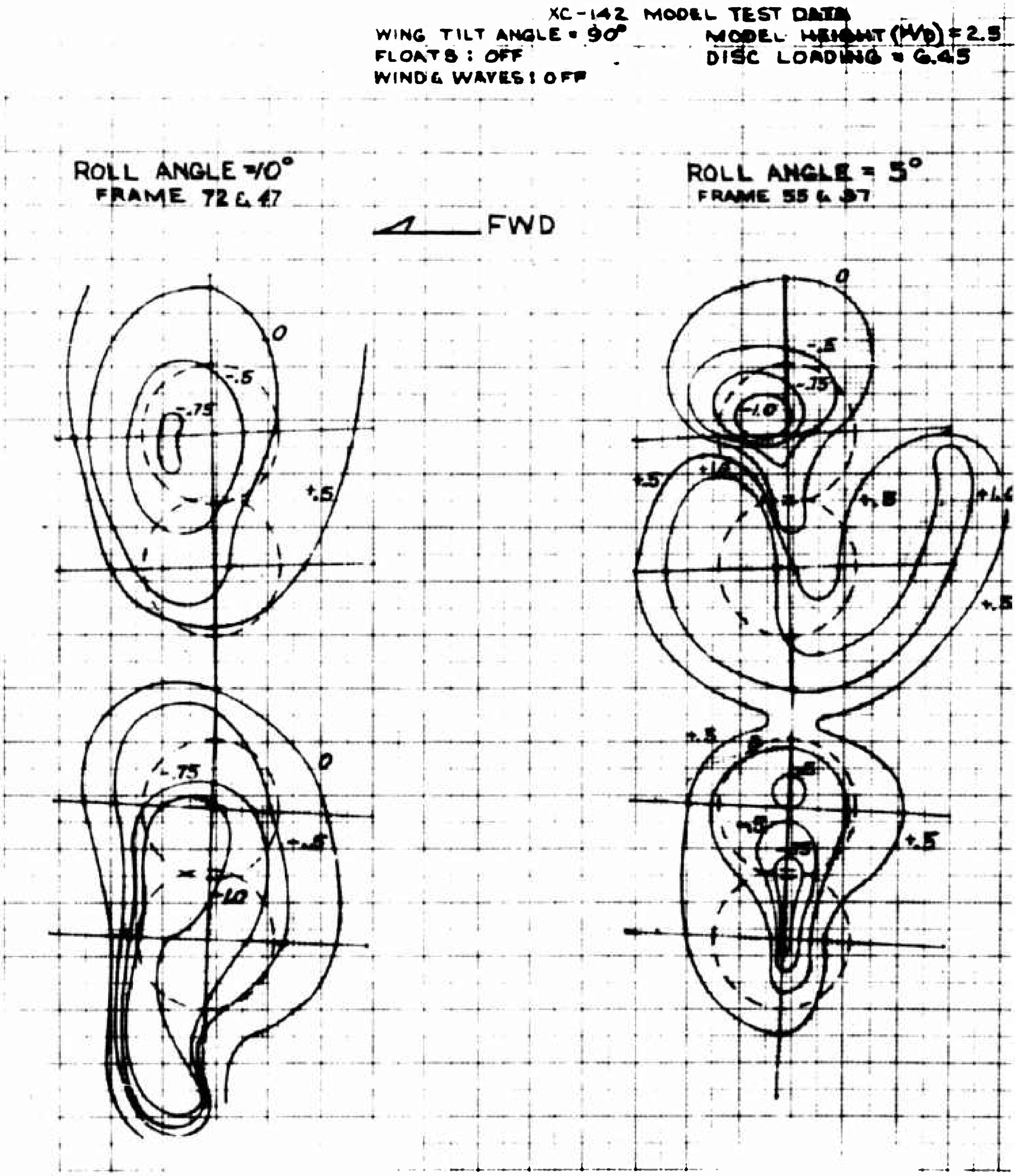
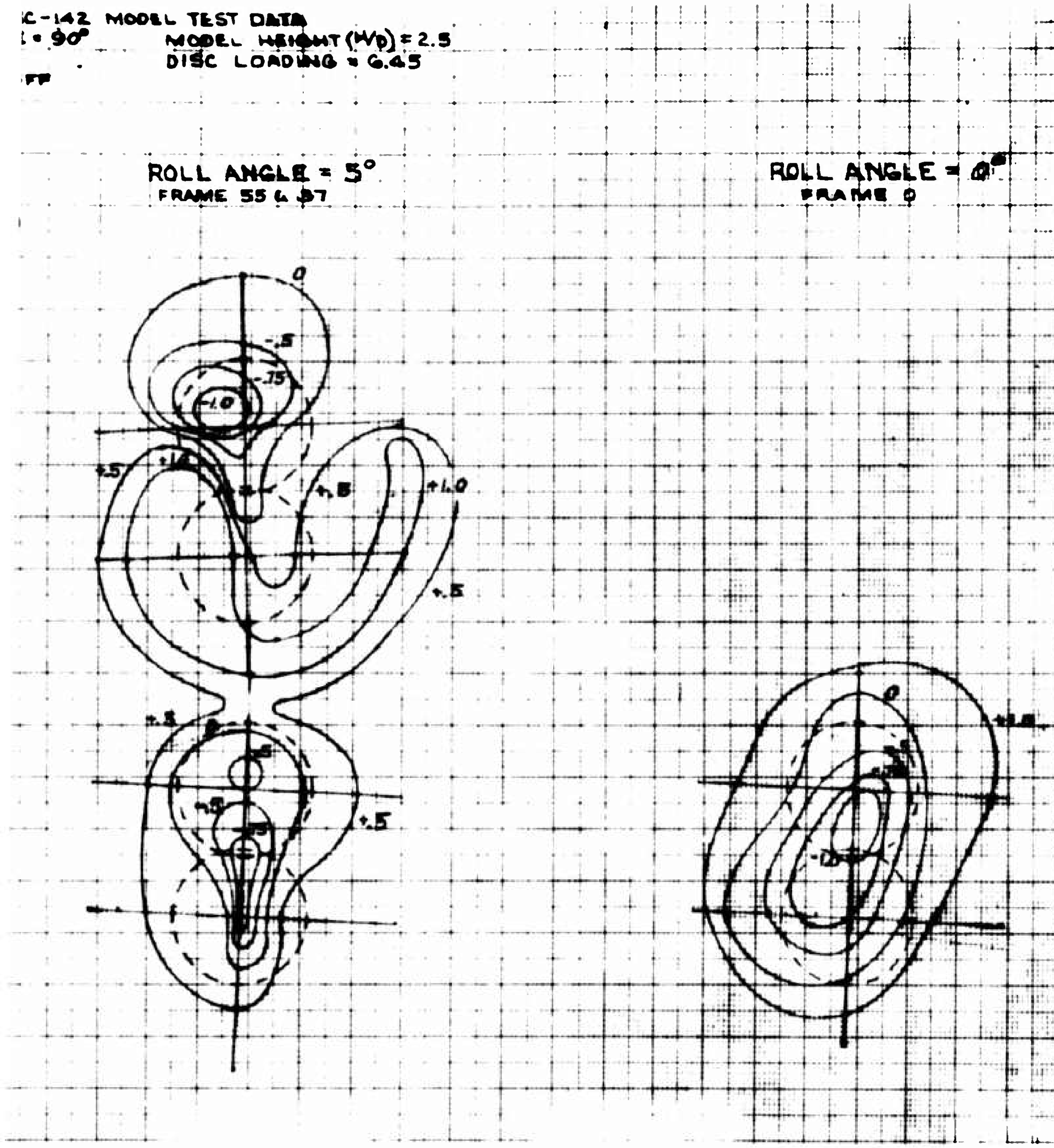


Figure 4-61 Water Displacement Topographical Plot — Effects of Roll Angle

A



lacement Topographical Plot --
'ects of Roll Angle

B

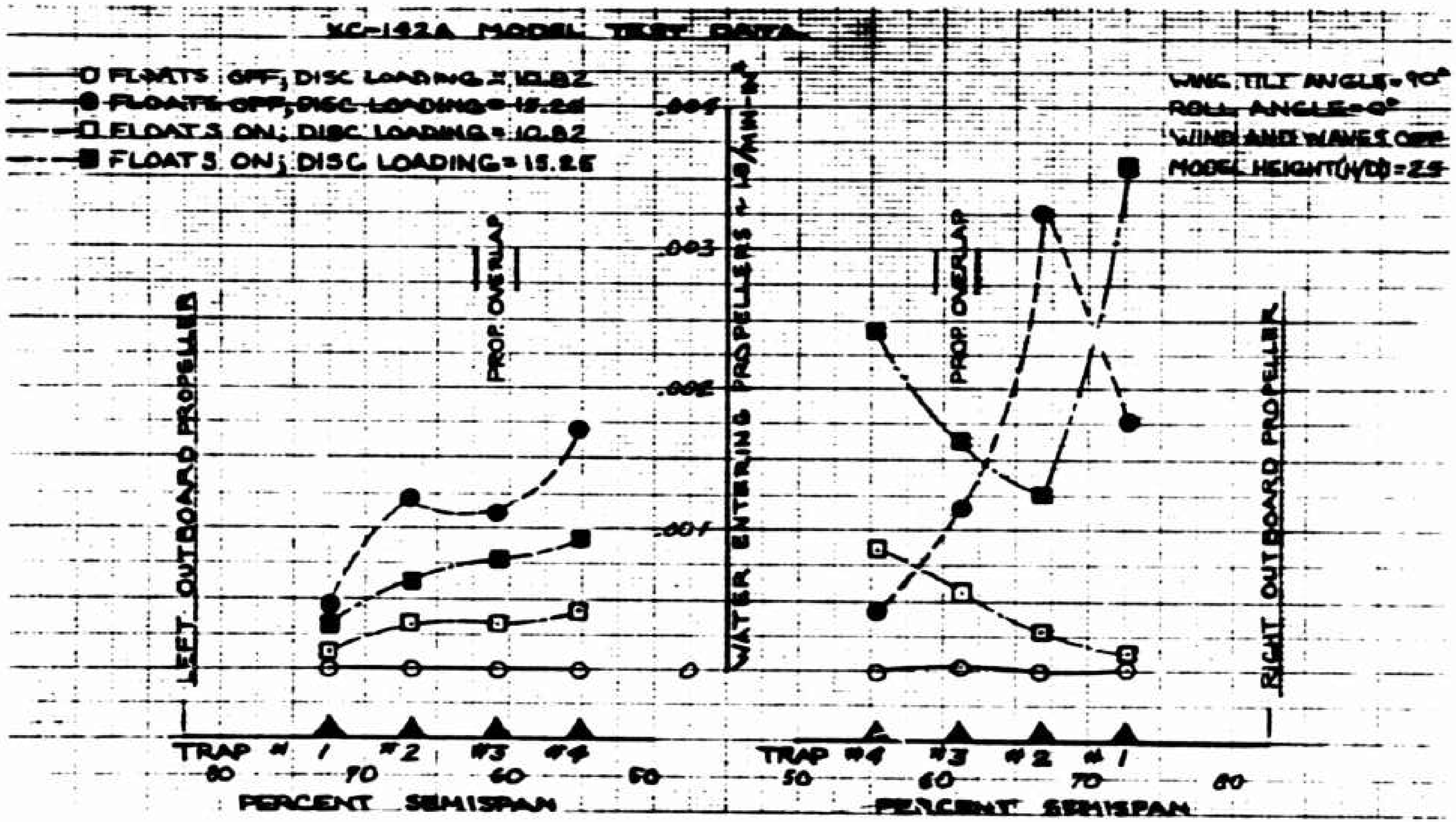


Figure 4-62 Water Entering Propellers - Effects of Vertical Floats

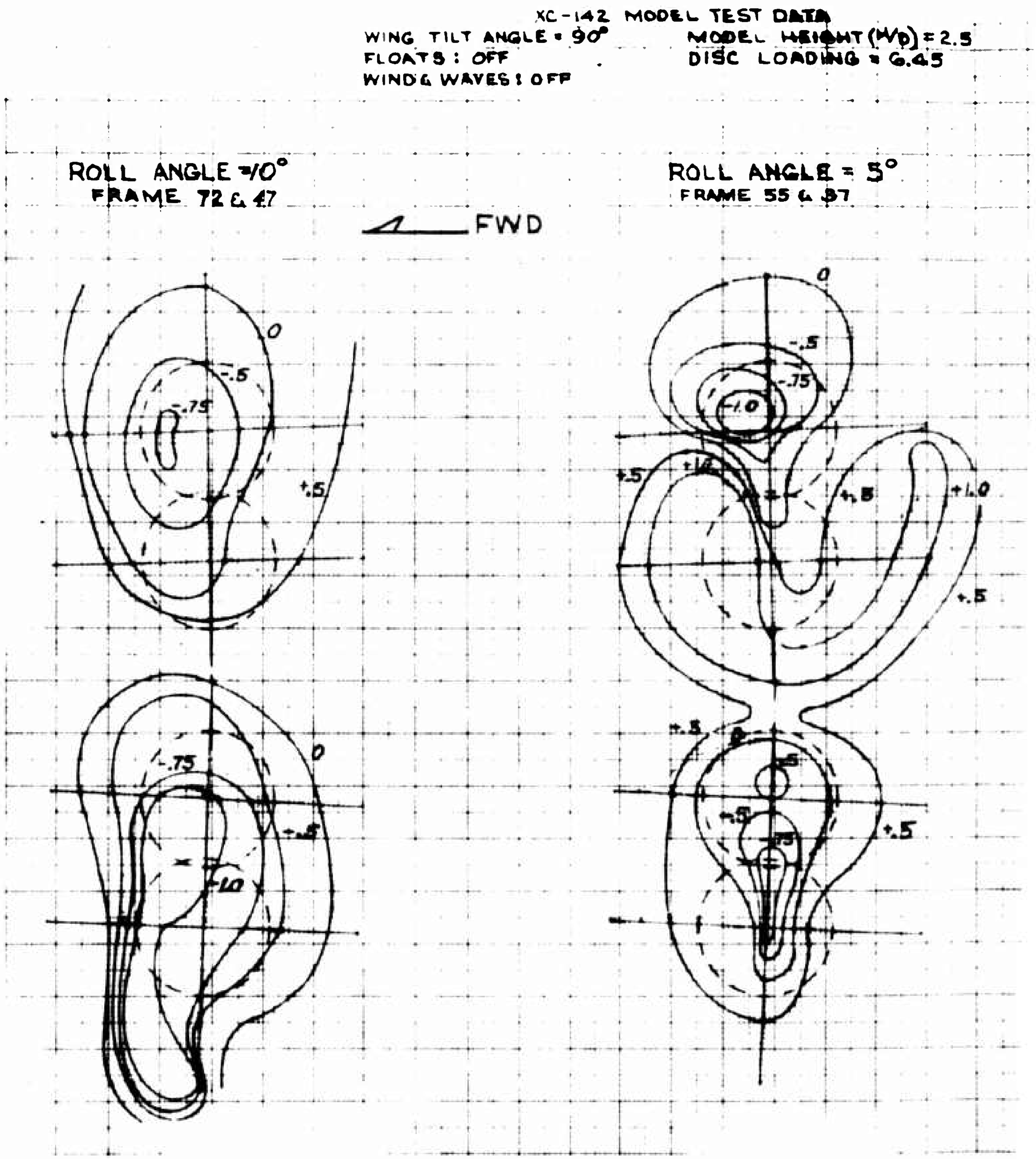
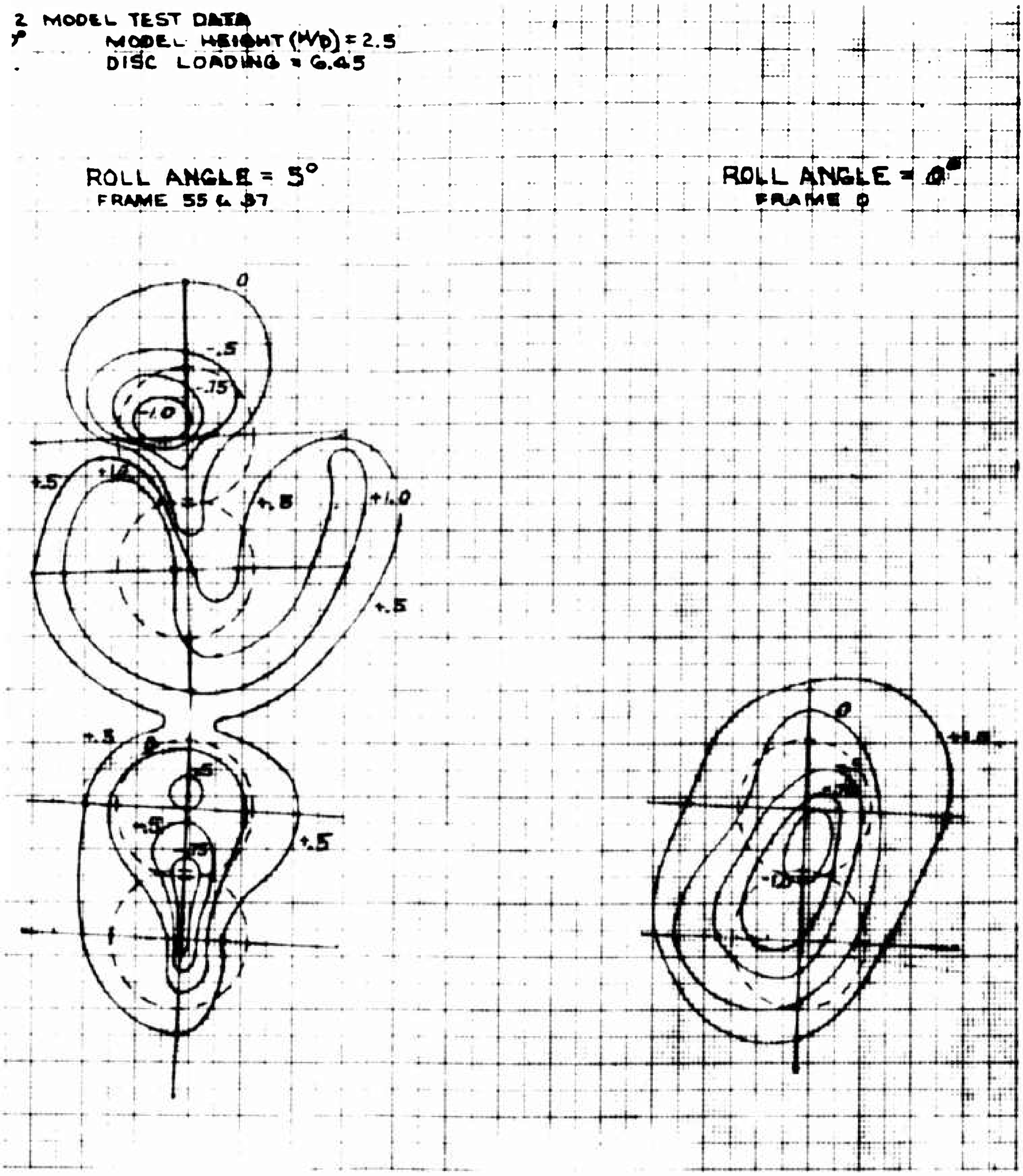


Figure 4-61 Water Displacement Topographical Plot -- Effects of Roll Angle

A

2 MODEL TEST DATA
MODEL HEIGHT (H/D) = 2.5
DISC LOADING = 6.45



...nt Topographical Plot --
...f Roll Angle

...-87

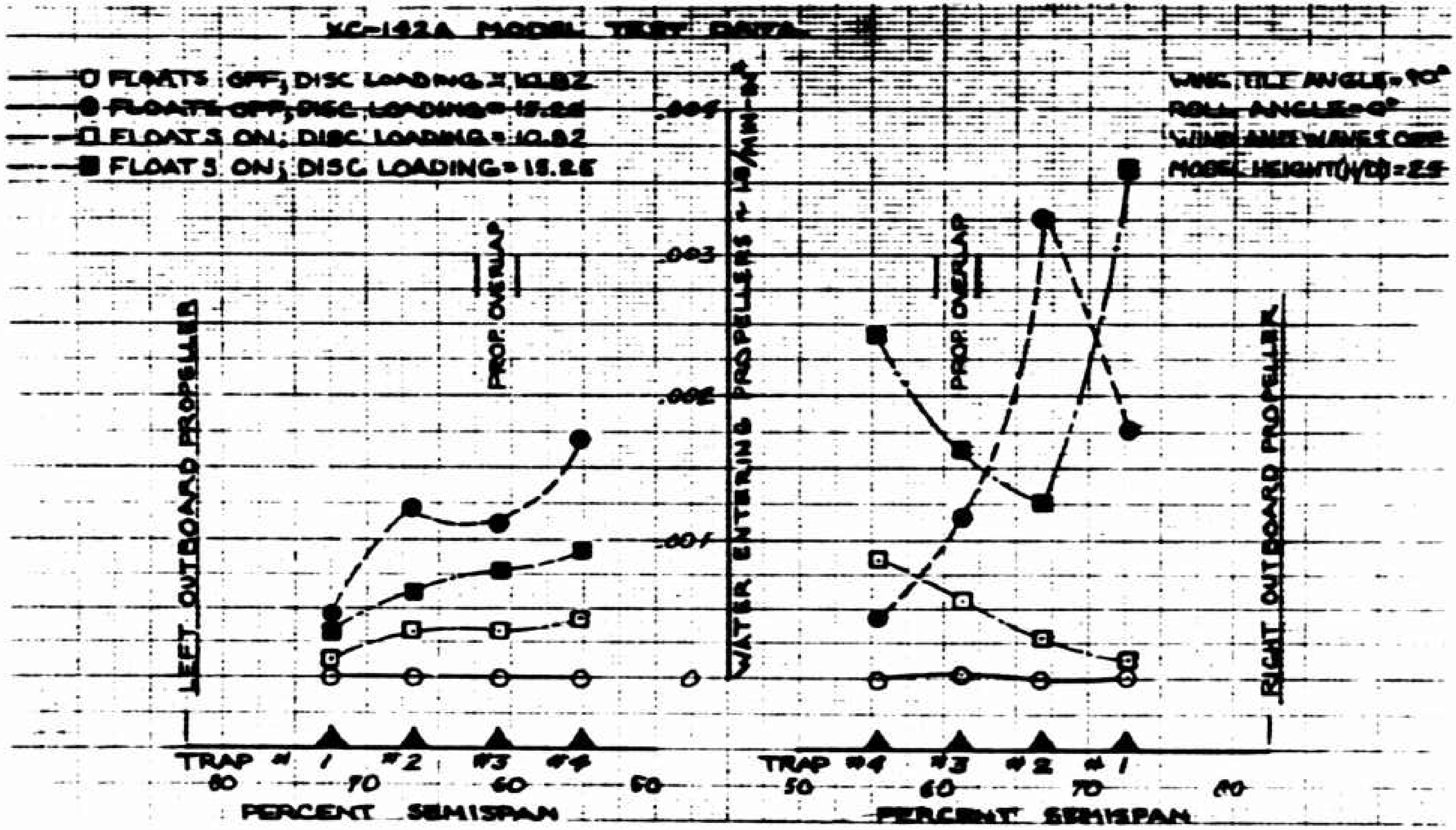


Figure 4-62 Water Entering Propellers - Effects of Vertical Floats

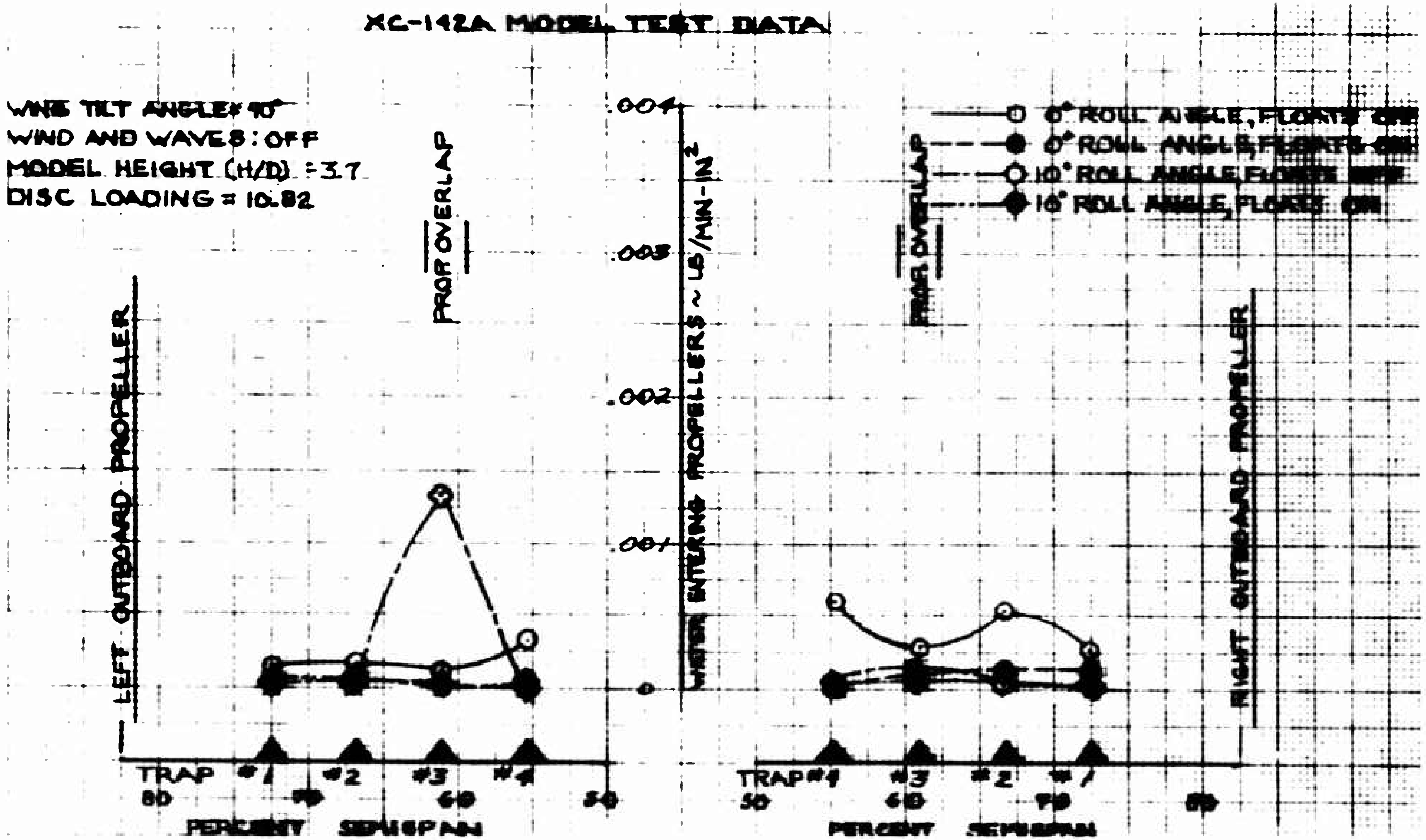


Figure 4-63 Water Entering Propellers – Effects of Vertical Floats

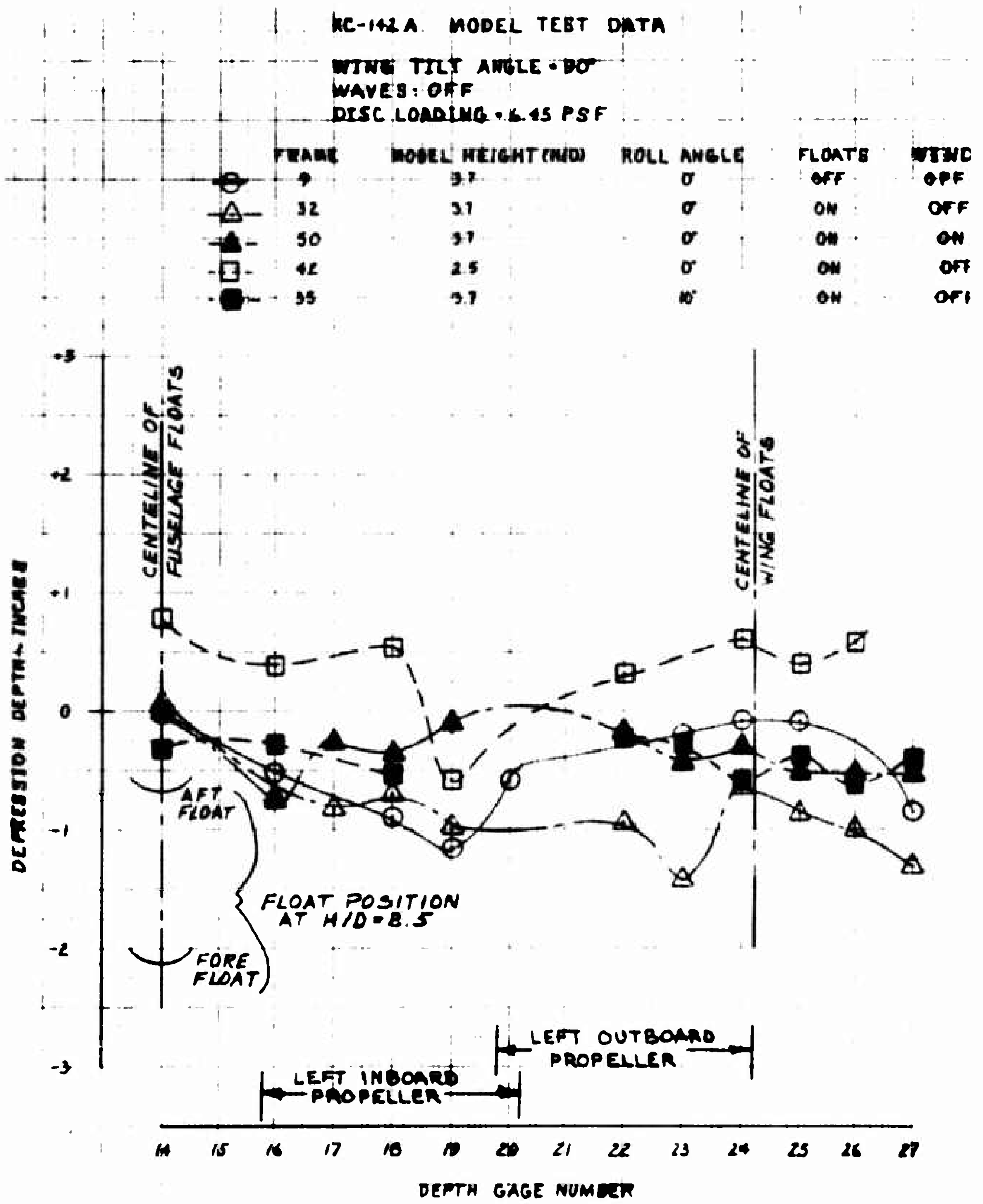


Figure 4-64 Water Displacement Along Propeller Centerline - Effects of Vertical Floats

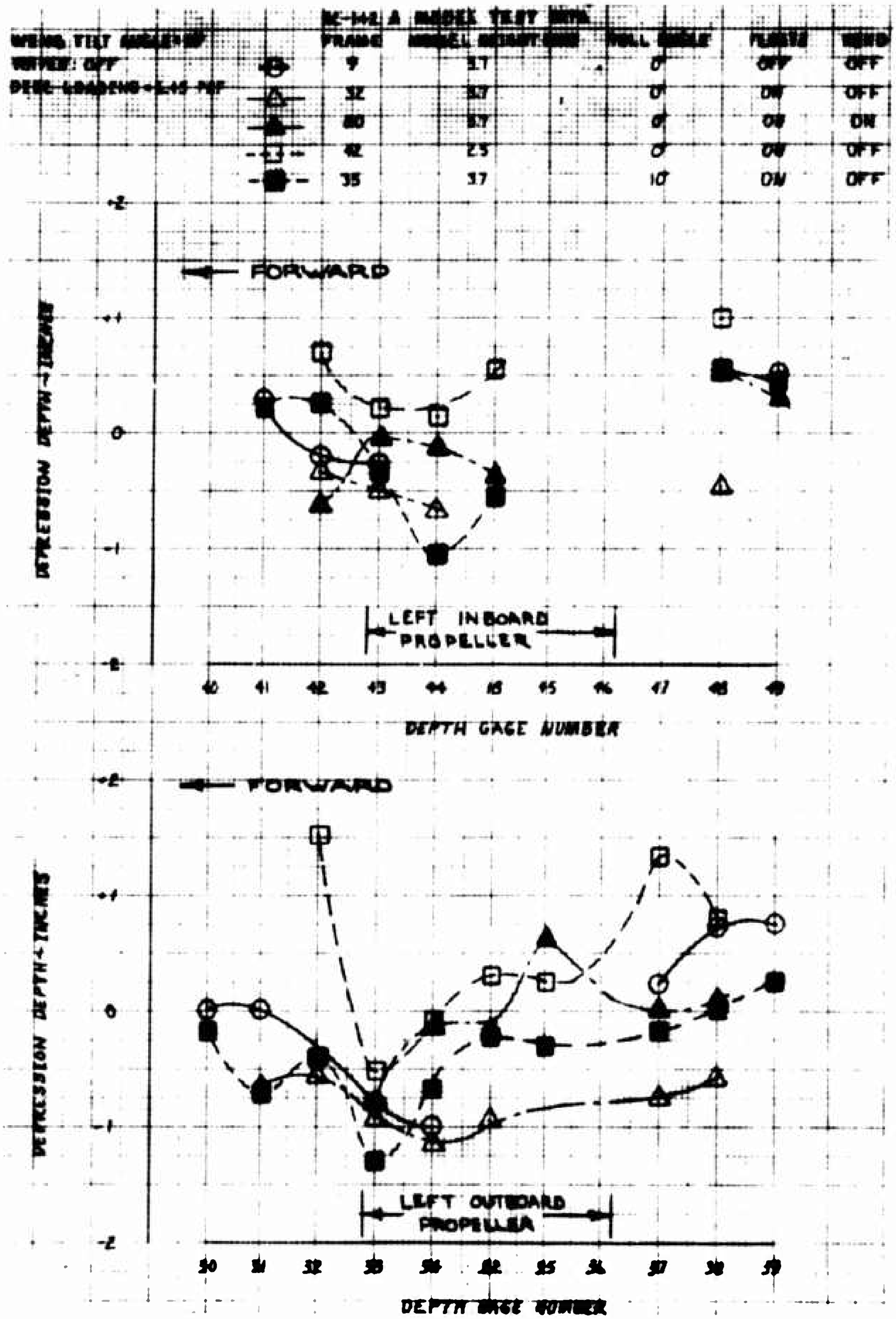


Figure 4-65 Water Displacement Fore and Aft — Effects of Vertical Floats

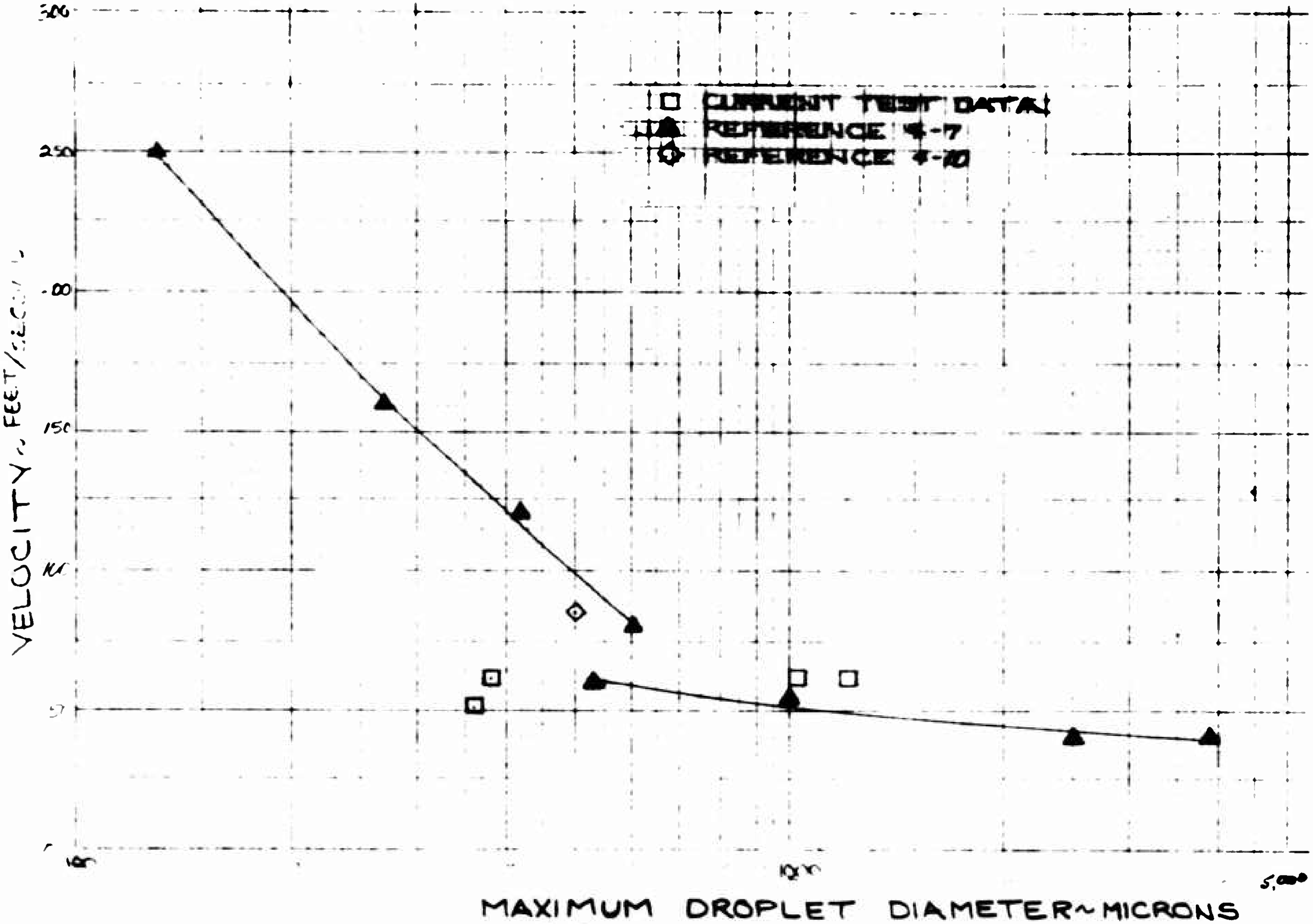


Figure 4-66 Maximum Droplet Size

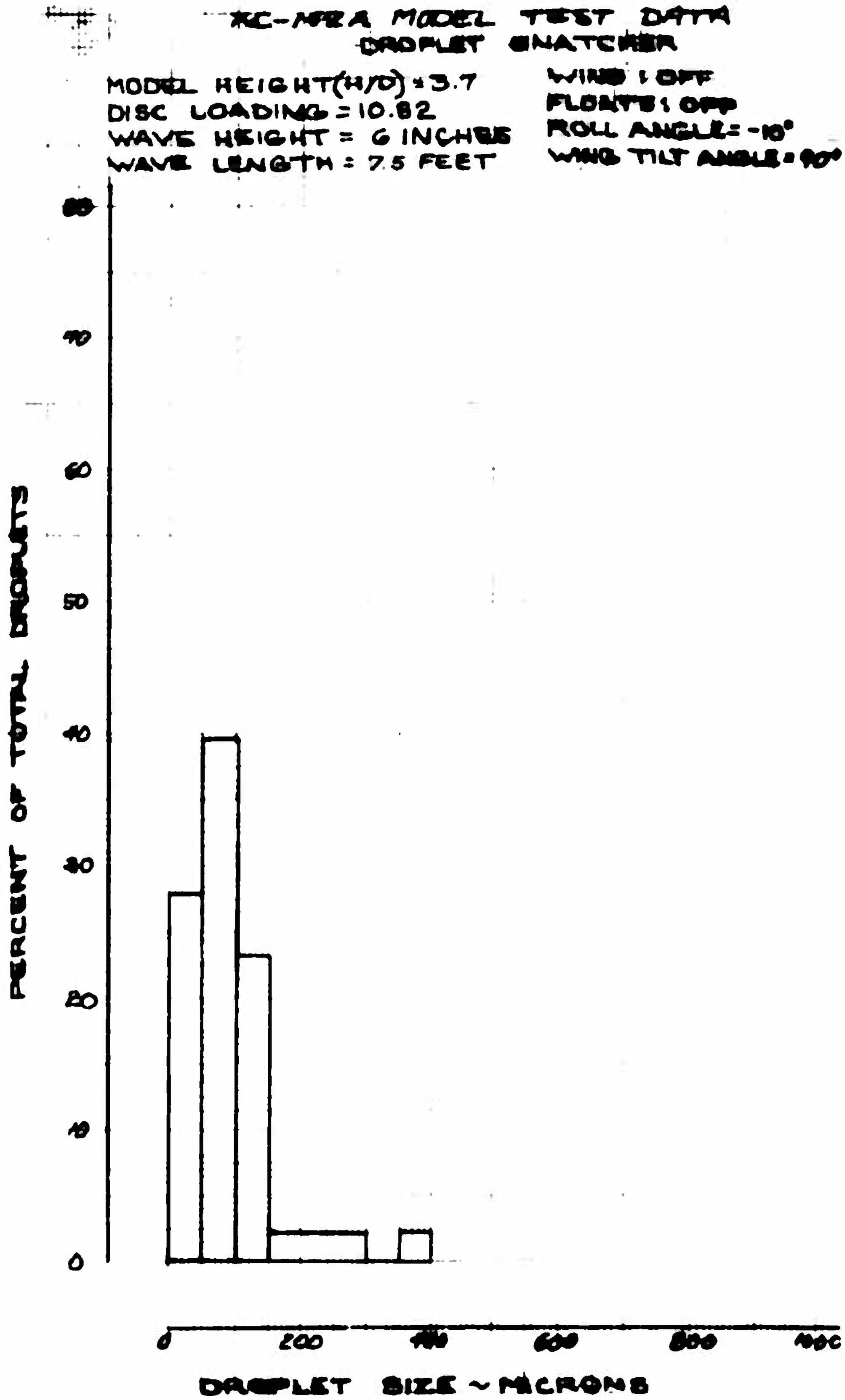


Figure 4-67 Water Droplet Size

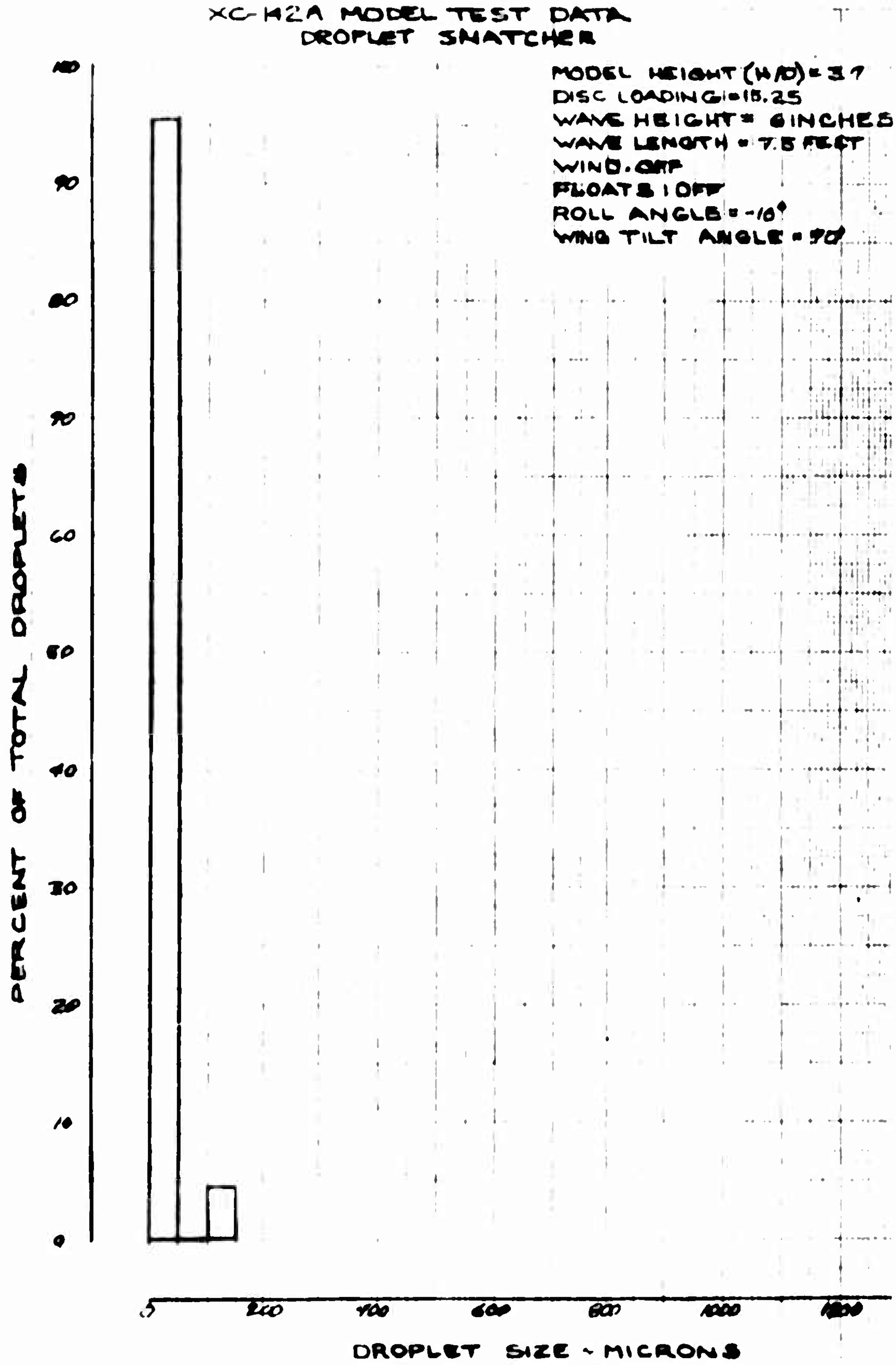


Figure 4-68 Water Droplet Size

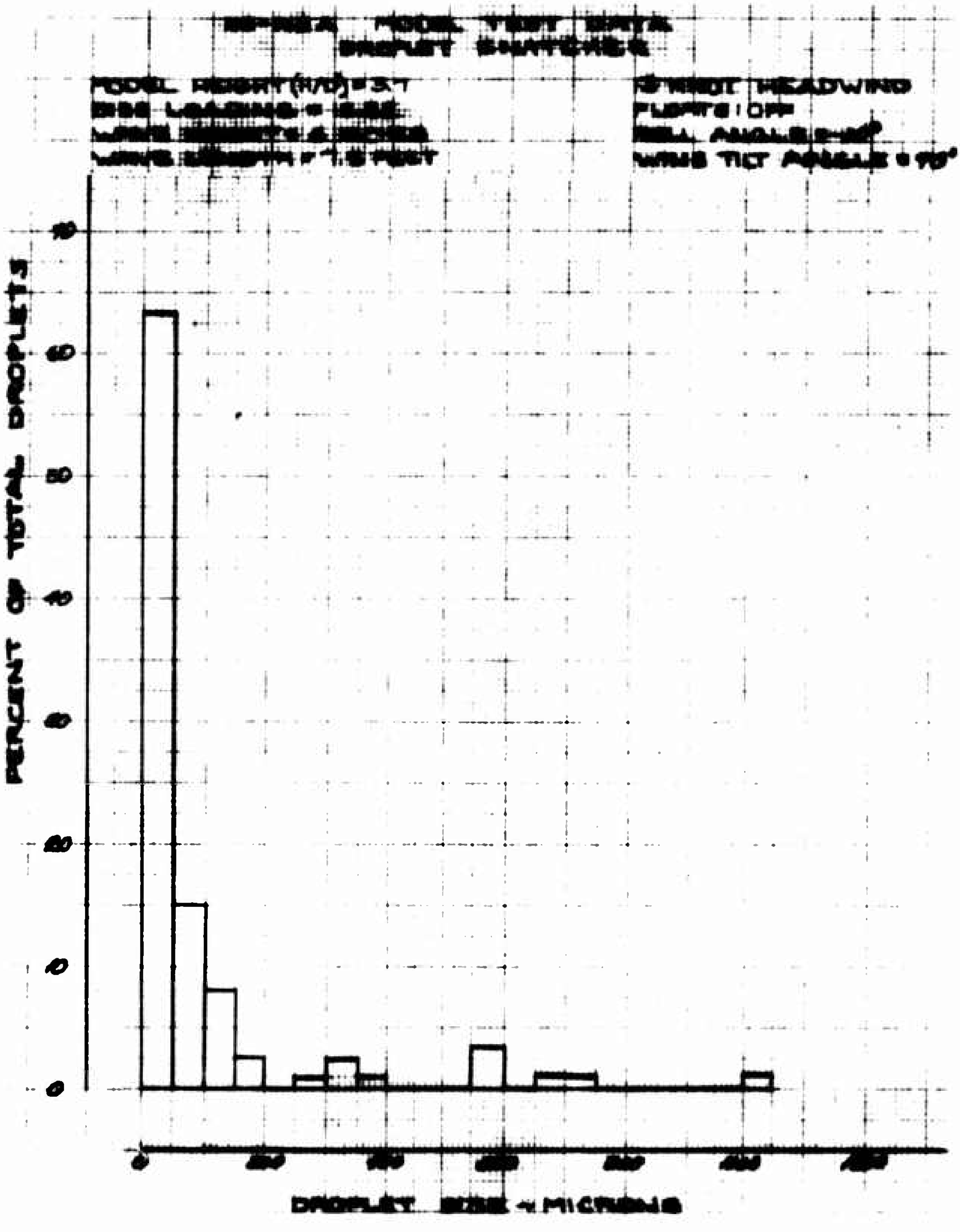


Figure 4-69 Water Droplet Size

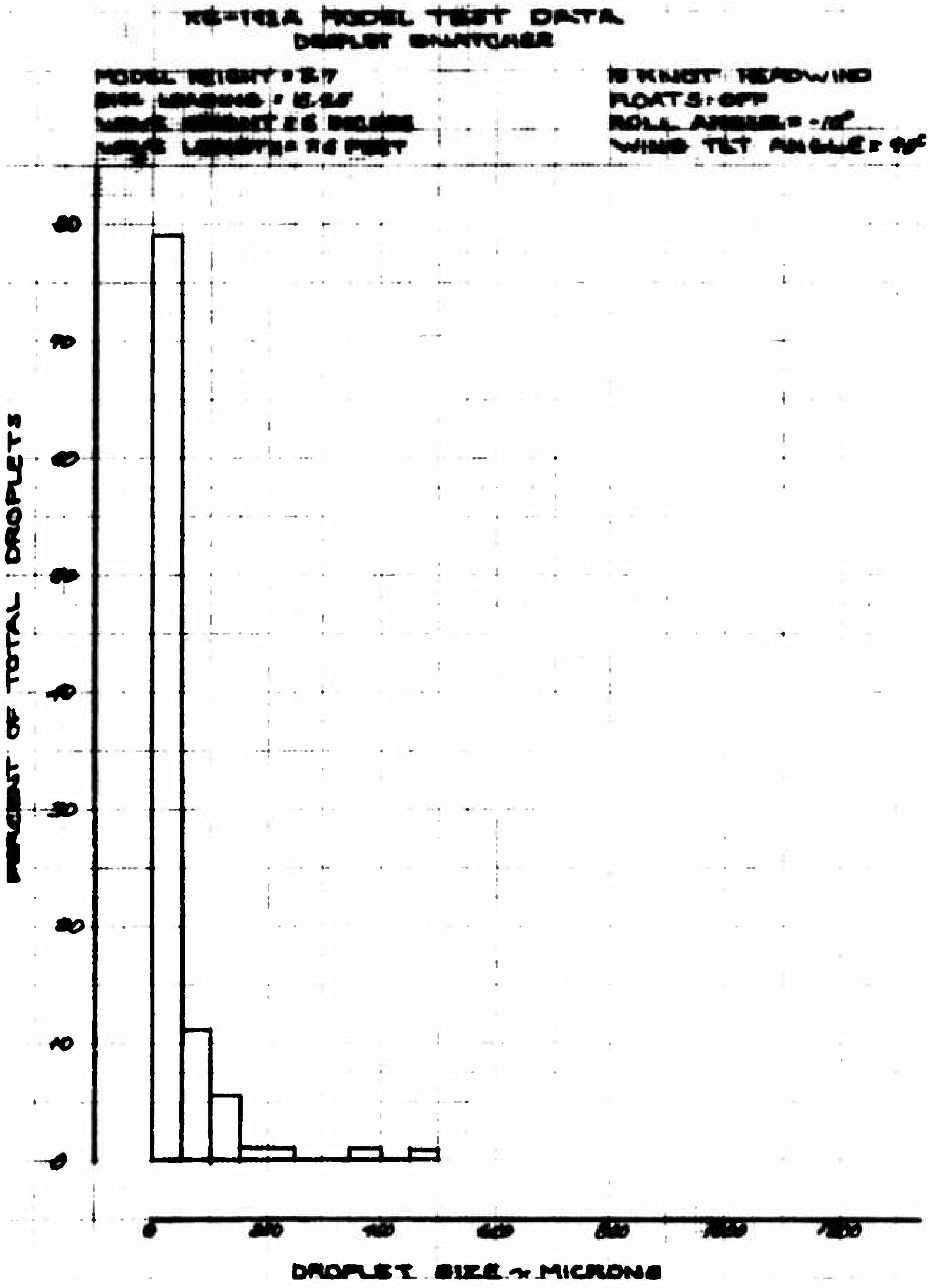


Figure 4-70 Water Droplet Size

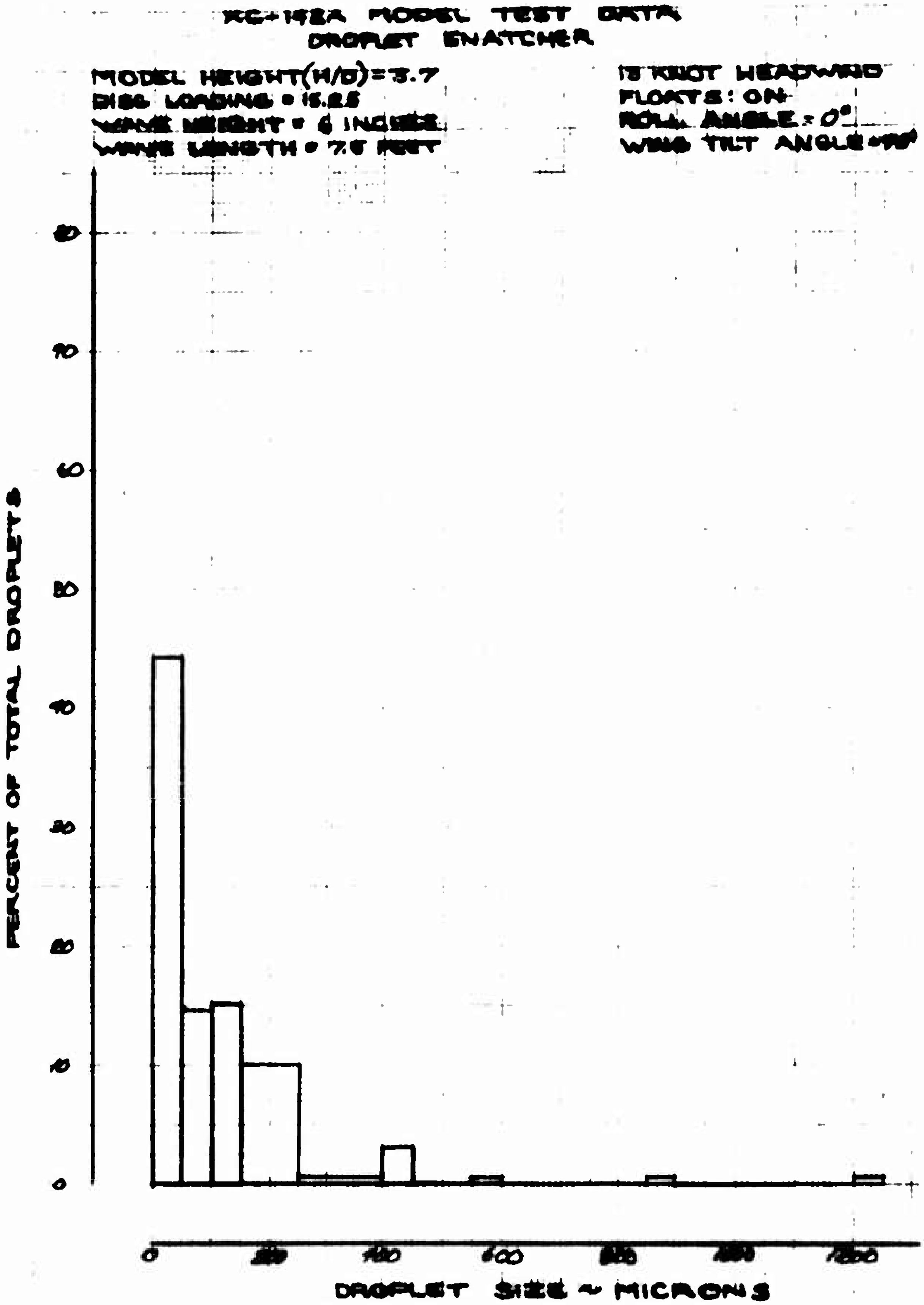


Figure 4-71 Water Droplet Size

Figure 4-72 Typical Microphotograph of Glass Slide from Droplet Snatcher

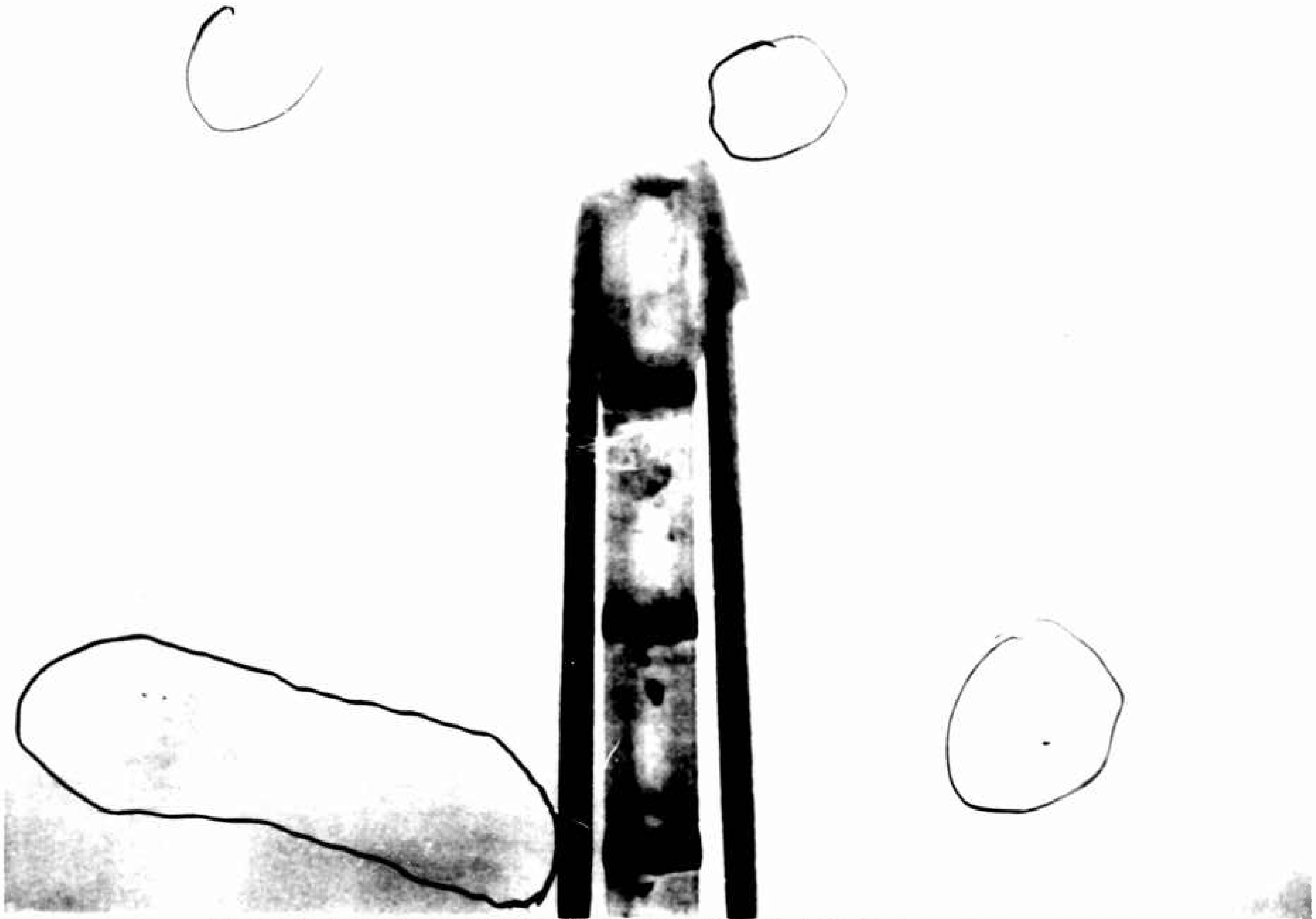


Figure 4-73 Typical Photograph of Depth Gage Number 28 through 40-inch Lens

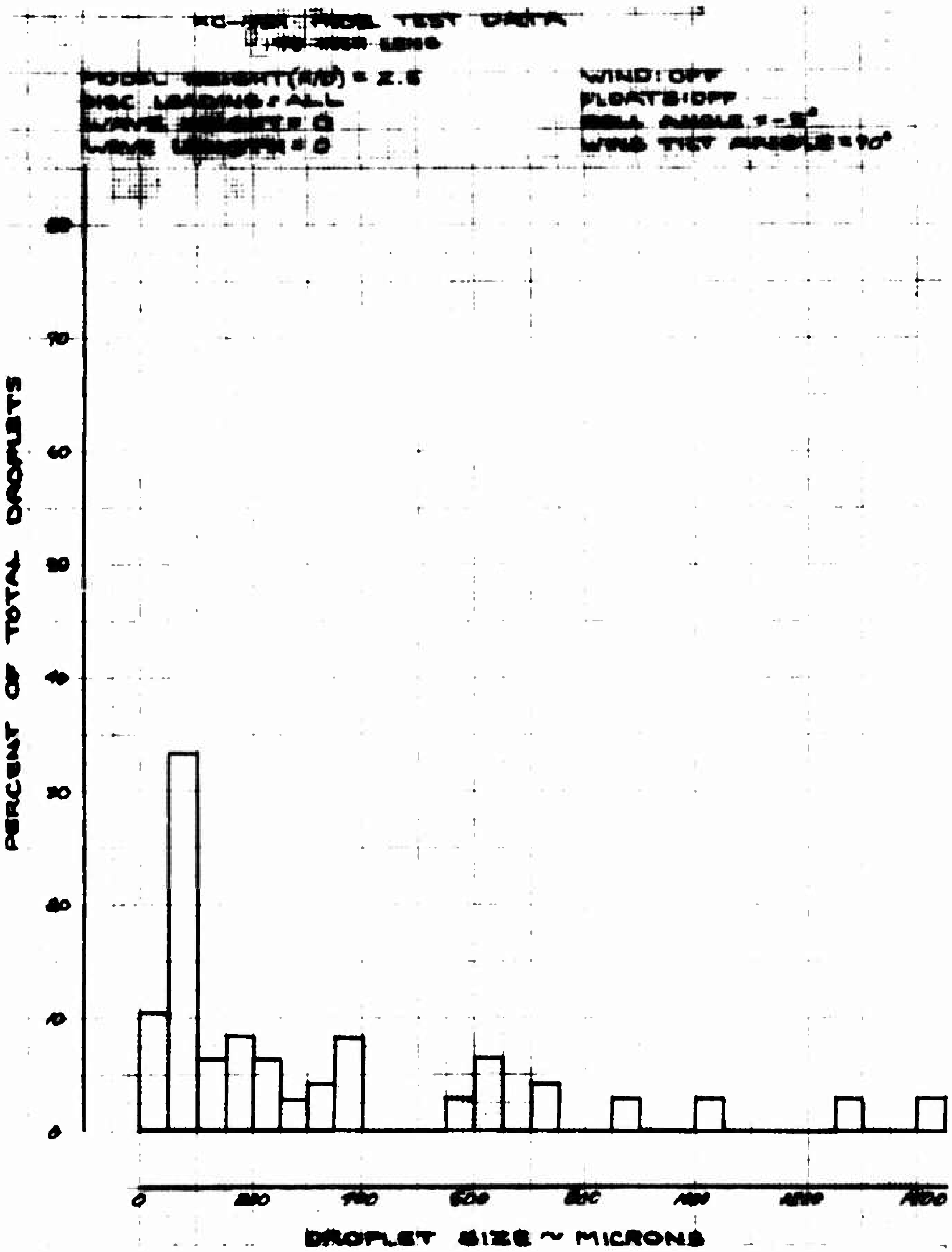


Figure 4-74 Water Droplet Size

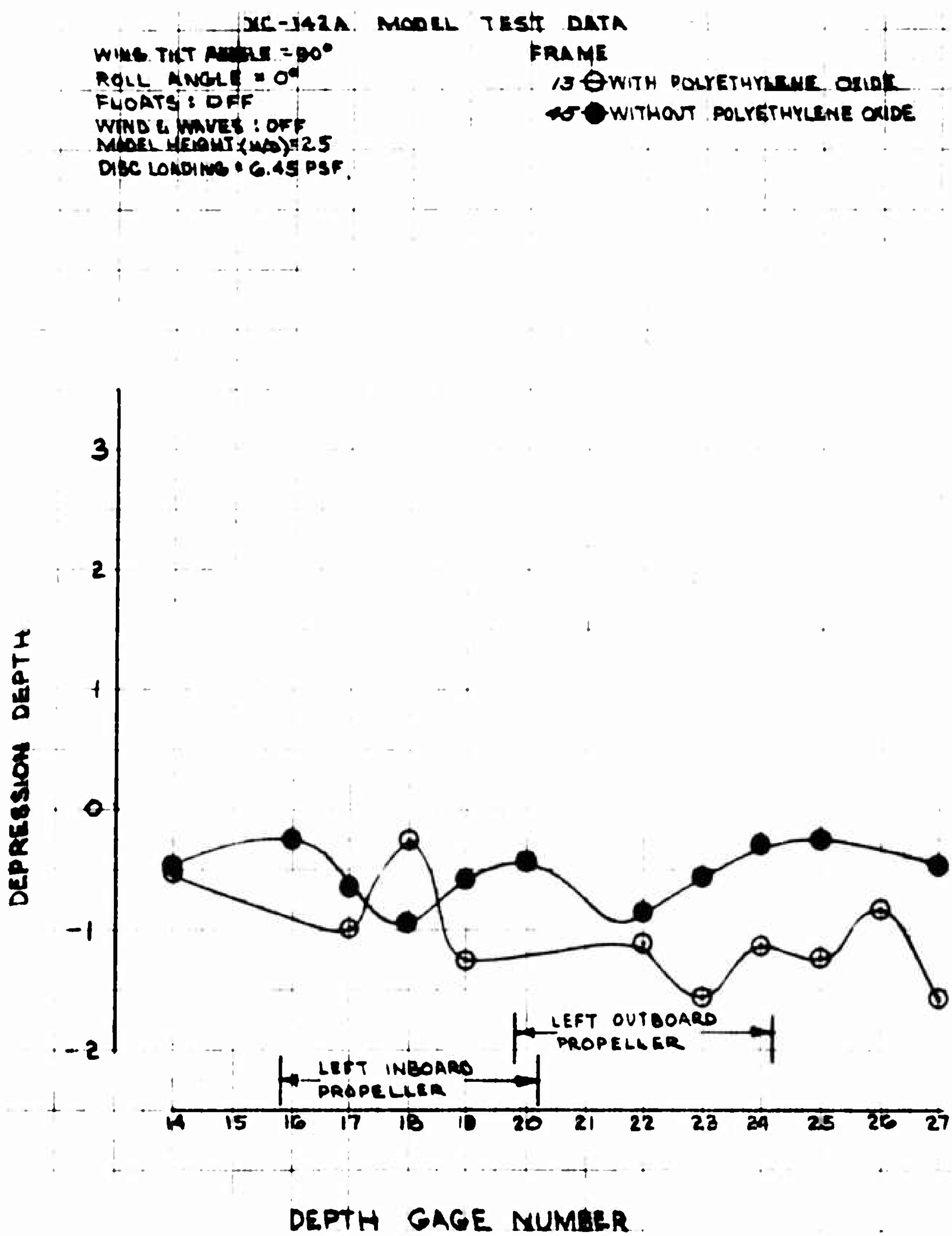


Figure 4-75 Water Displacement Along Propeller Centerline - Effects of Polyethylene Oxide

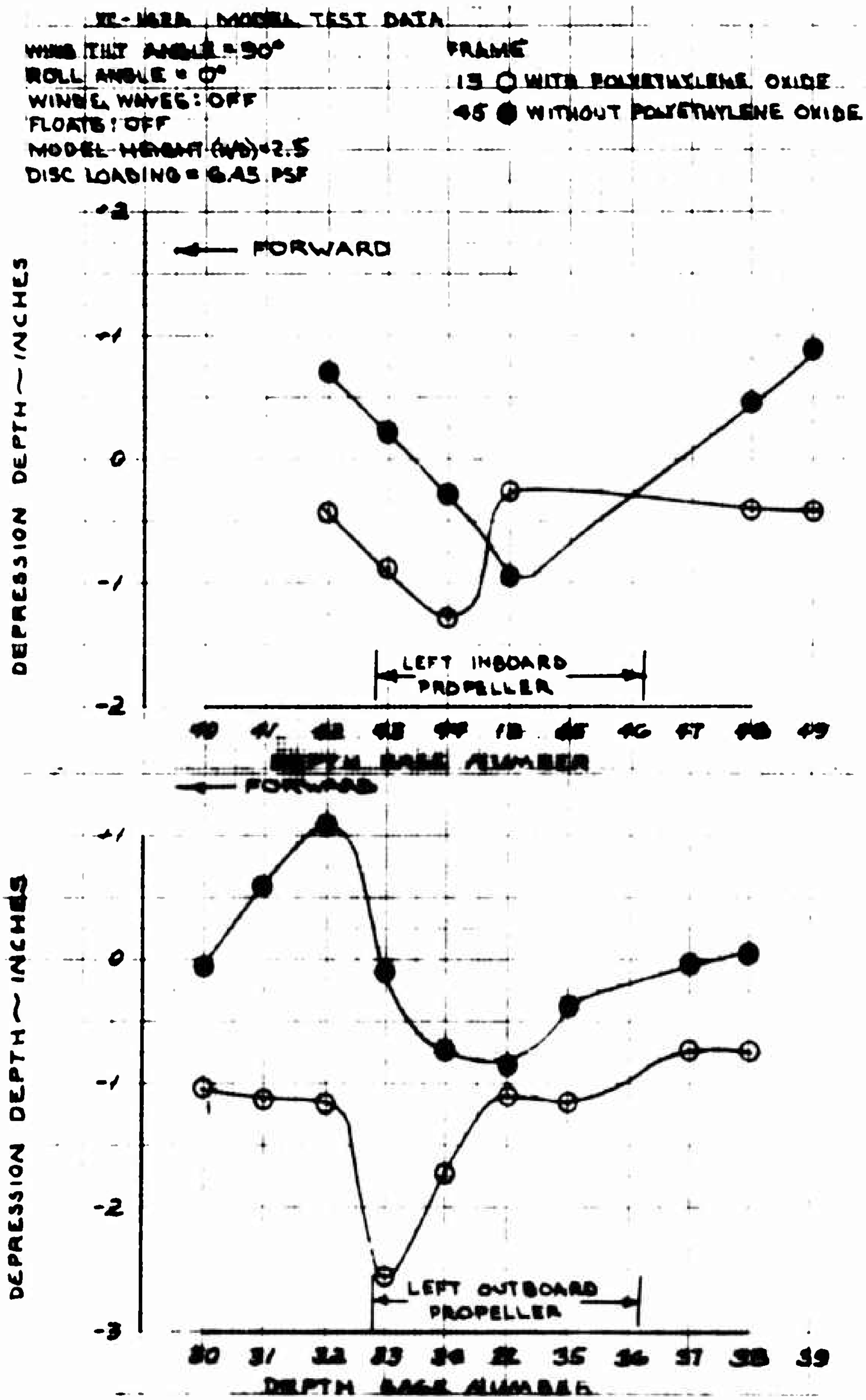


Figure 4-76 Water Displacement Fore and Aft — Effects of Polyethylene Oxide

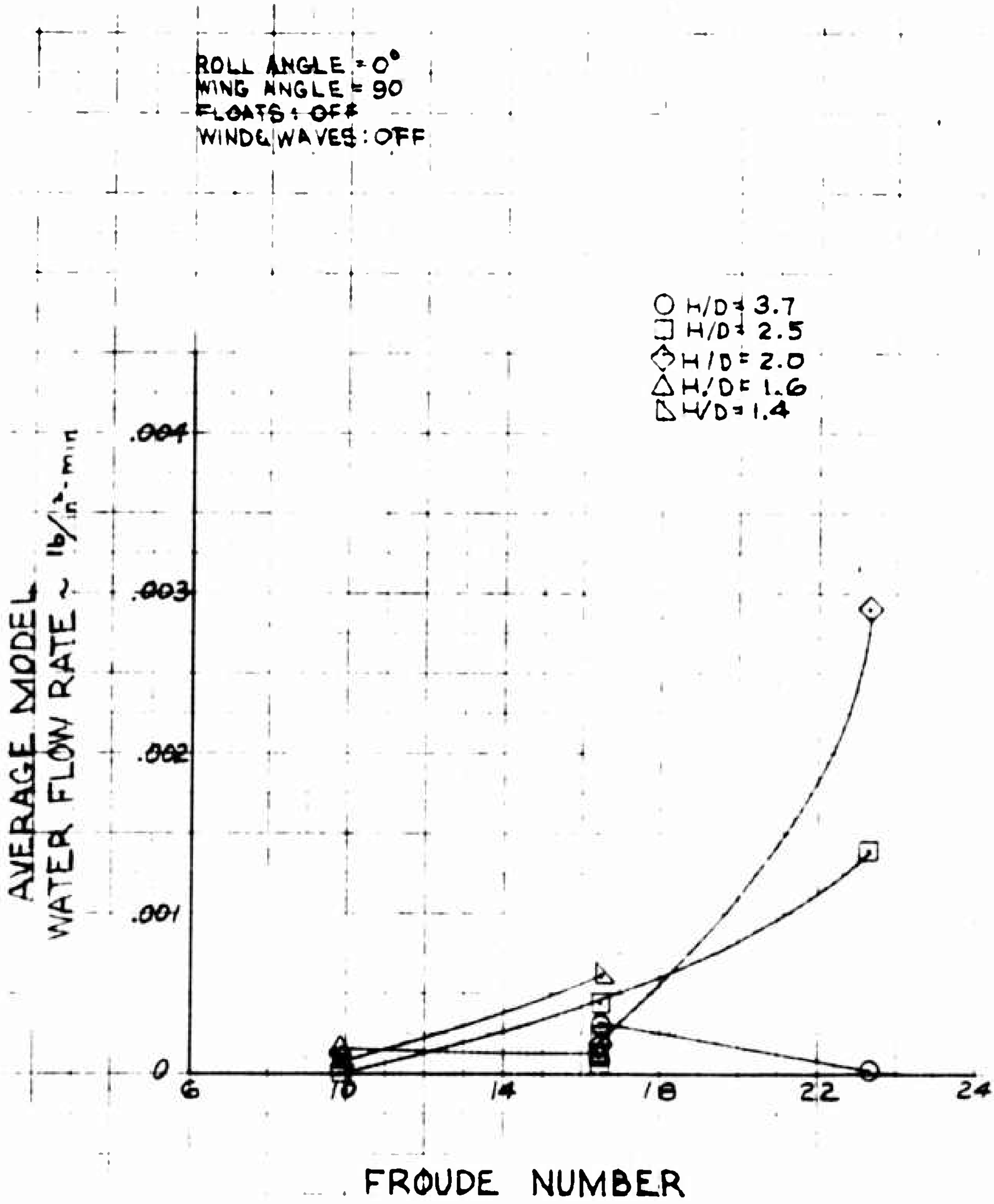


Figure 4-77 Effect of Froude Number on Average Moisture Circulation

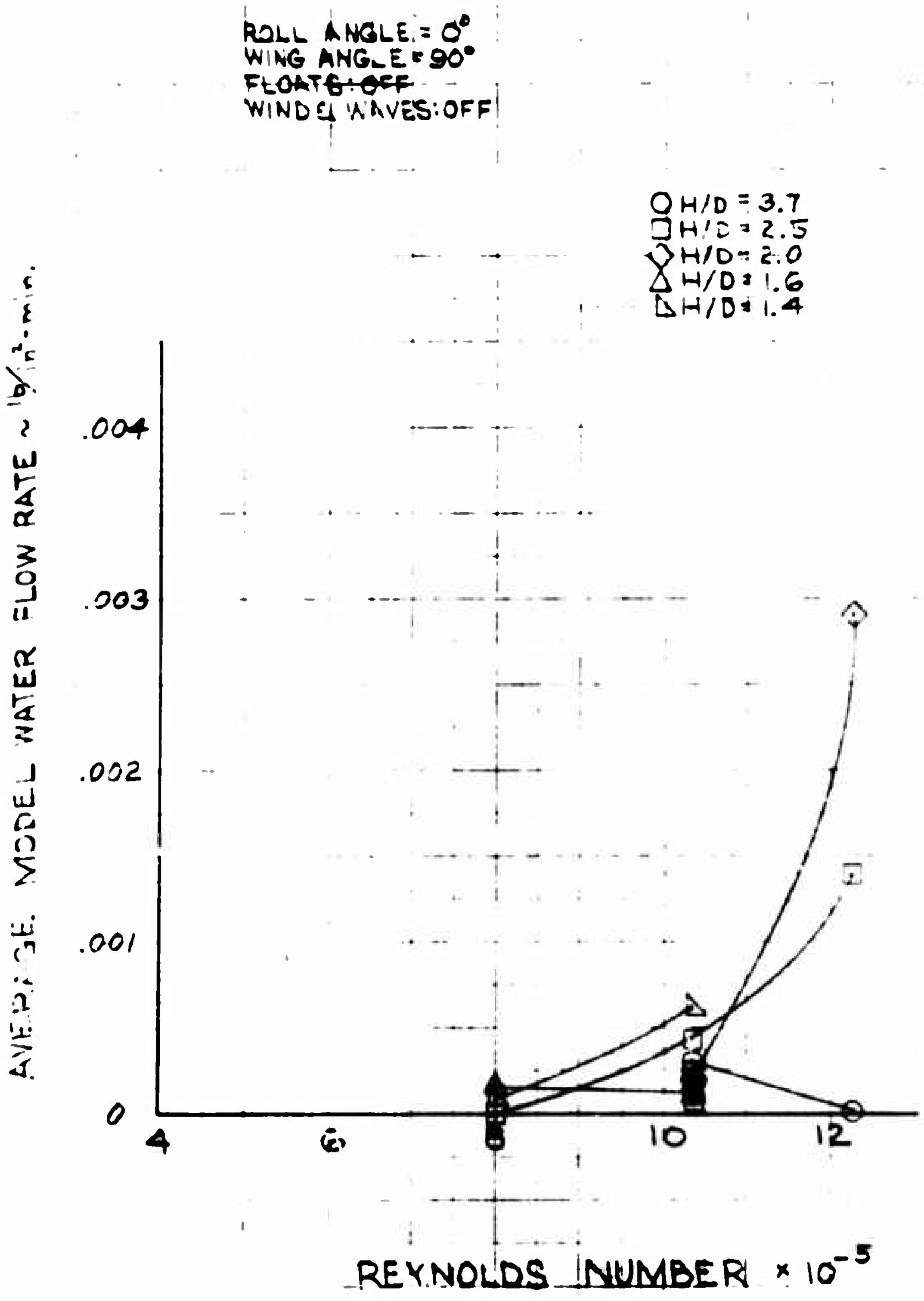


Figure 4-78 Effect of Reynolds Number on Average Moisture Circulation

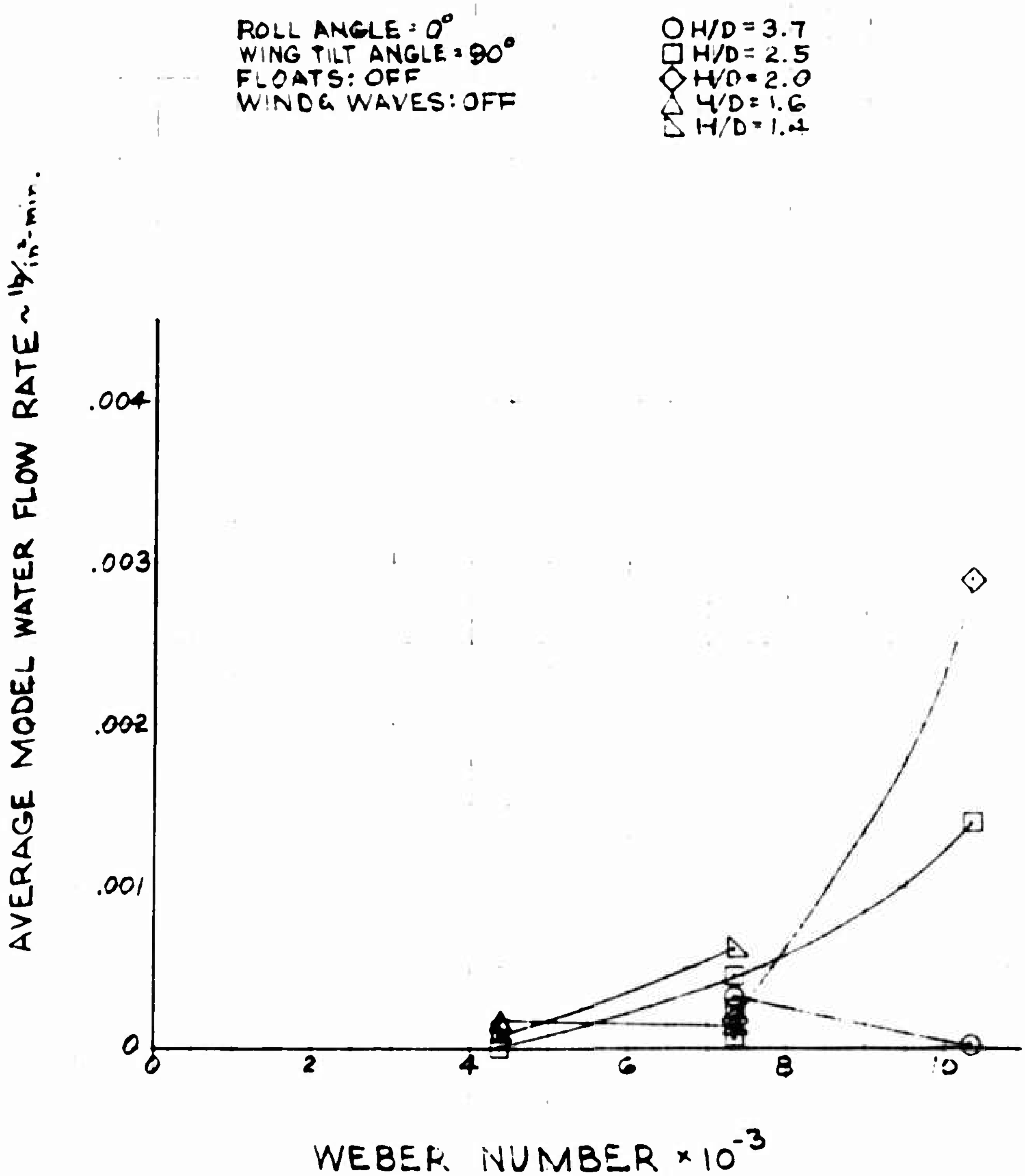


Figure 4-79 Effect of Weber Number on Average Moisture Circulation

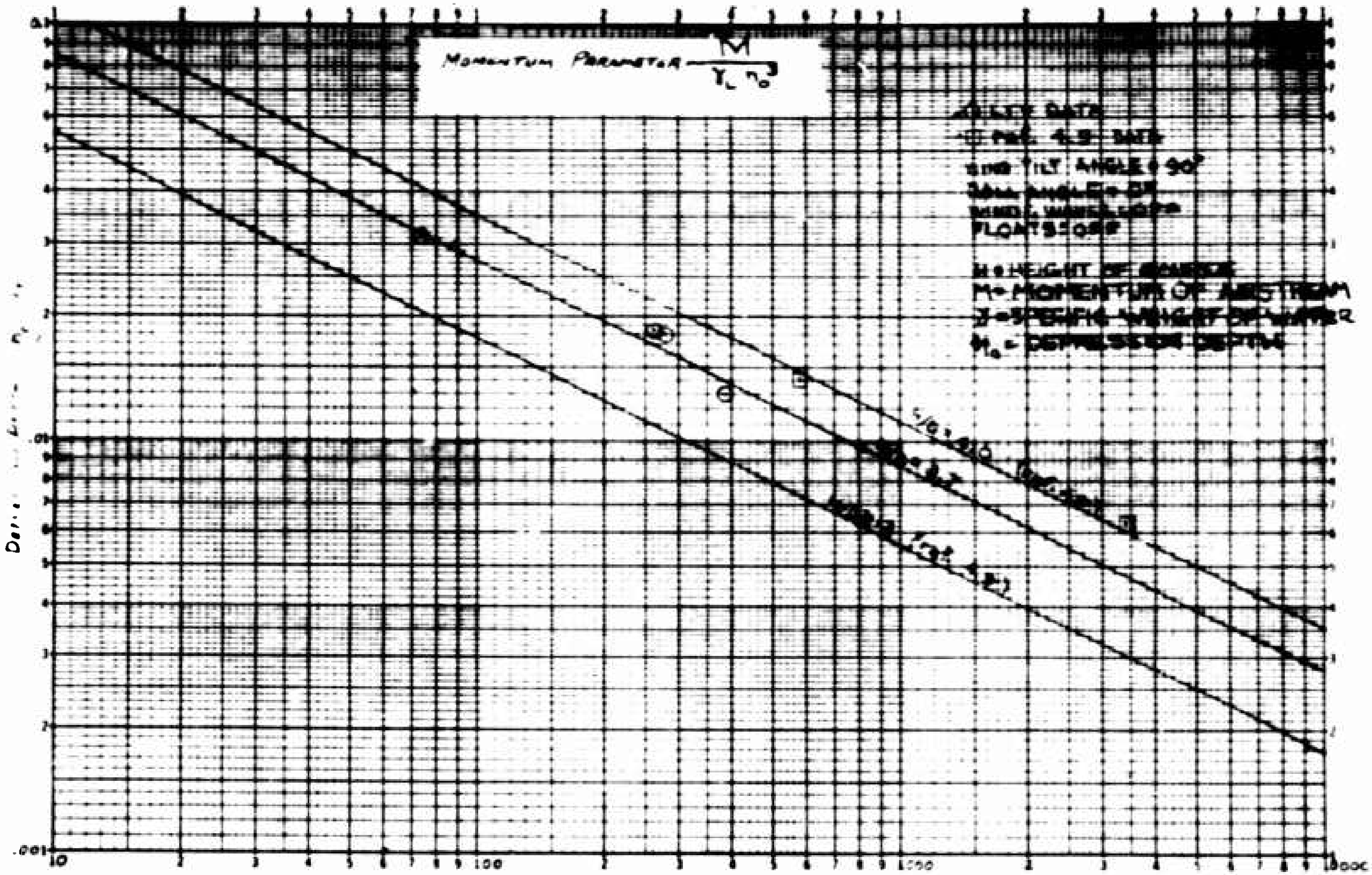


Figure 4-80 Effect of Disc Loading on Depression Depth

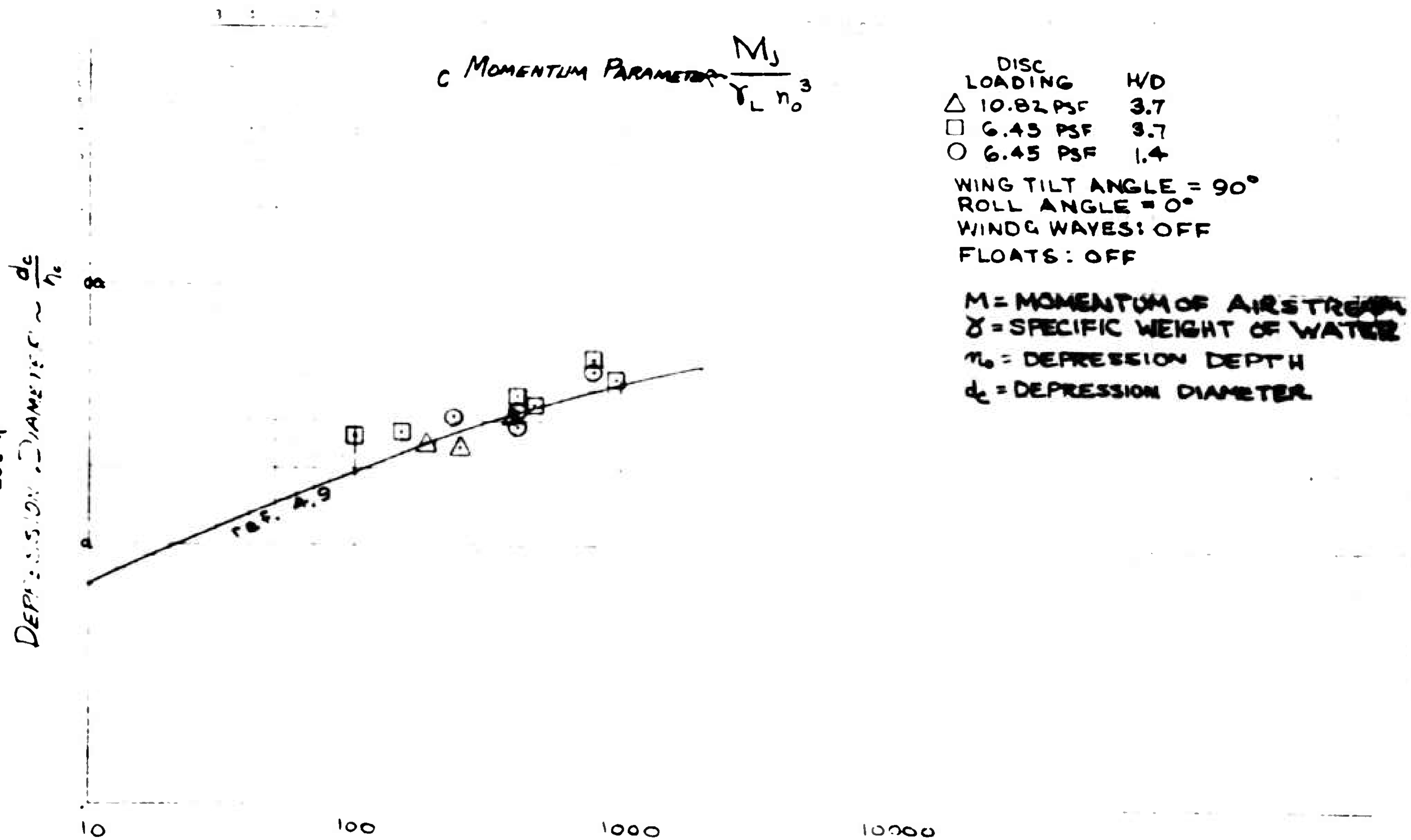


Figure 4-81 Effect of Disc Loading on Depression Width/Depth

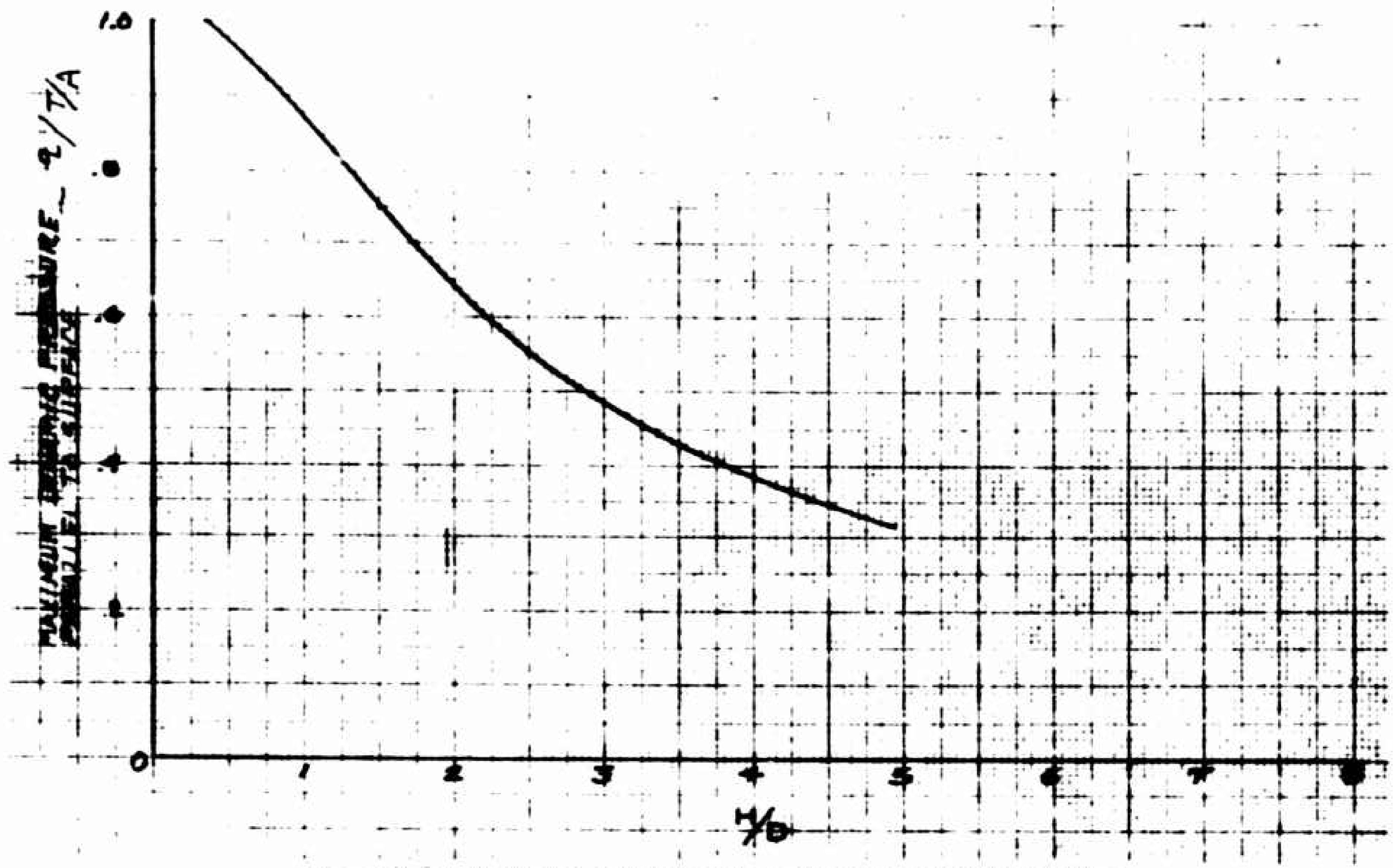


Figure 4-82 Variation of Maximum Dynamic Pressure of Ground Flow with Height for Propellers

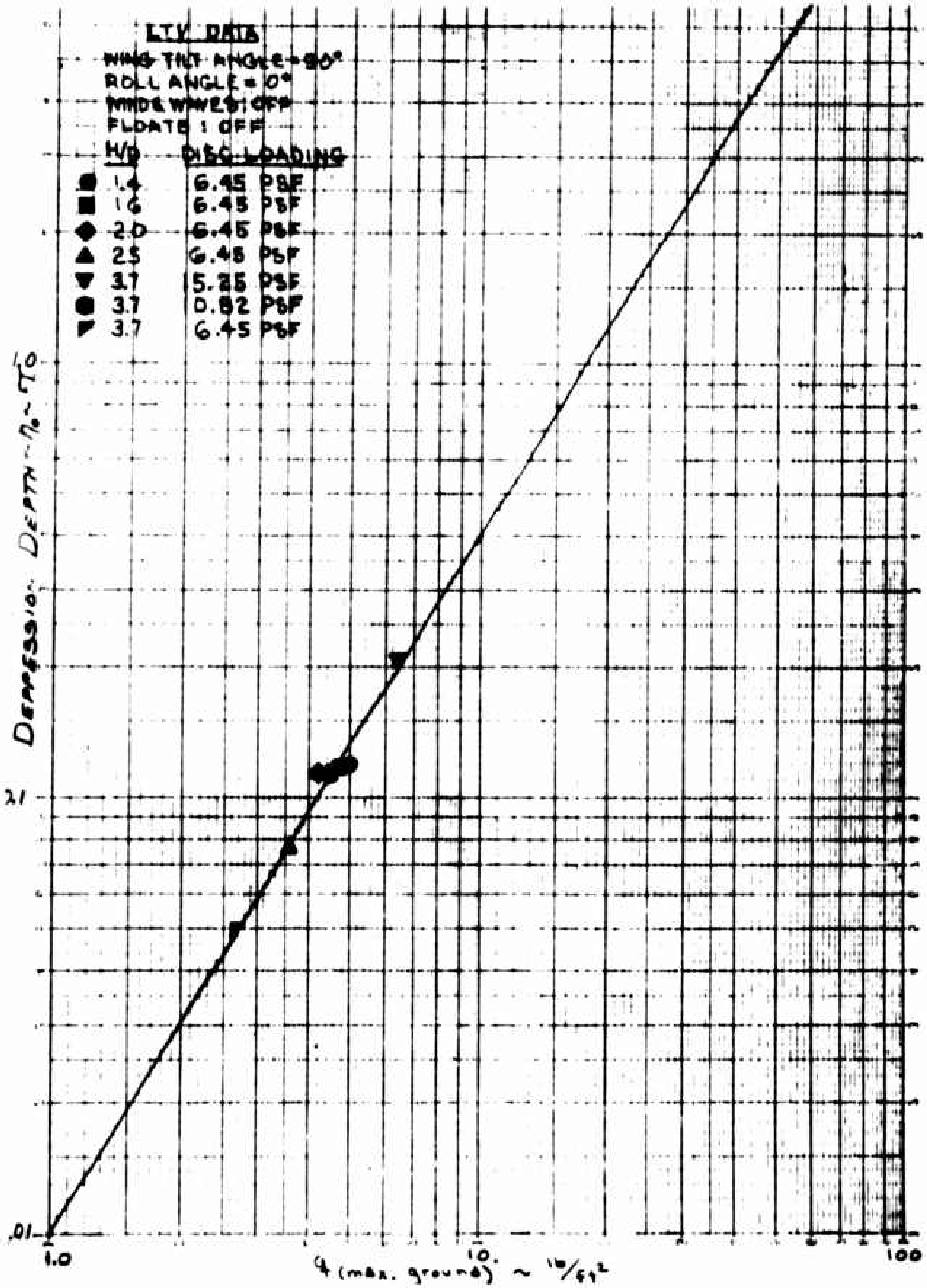


Figure 4-83 Effect of Maximum Ground Dynamic Pressure on Depression Depth

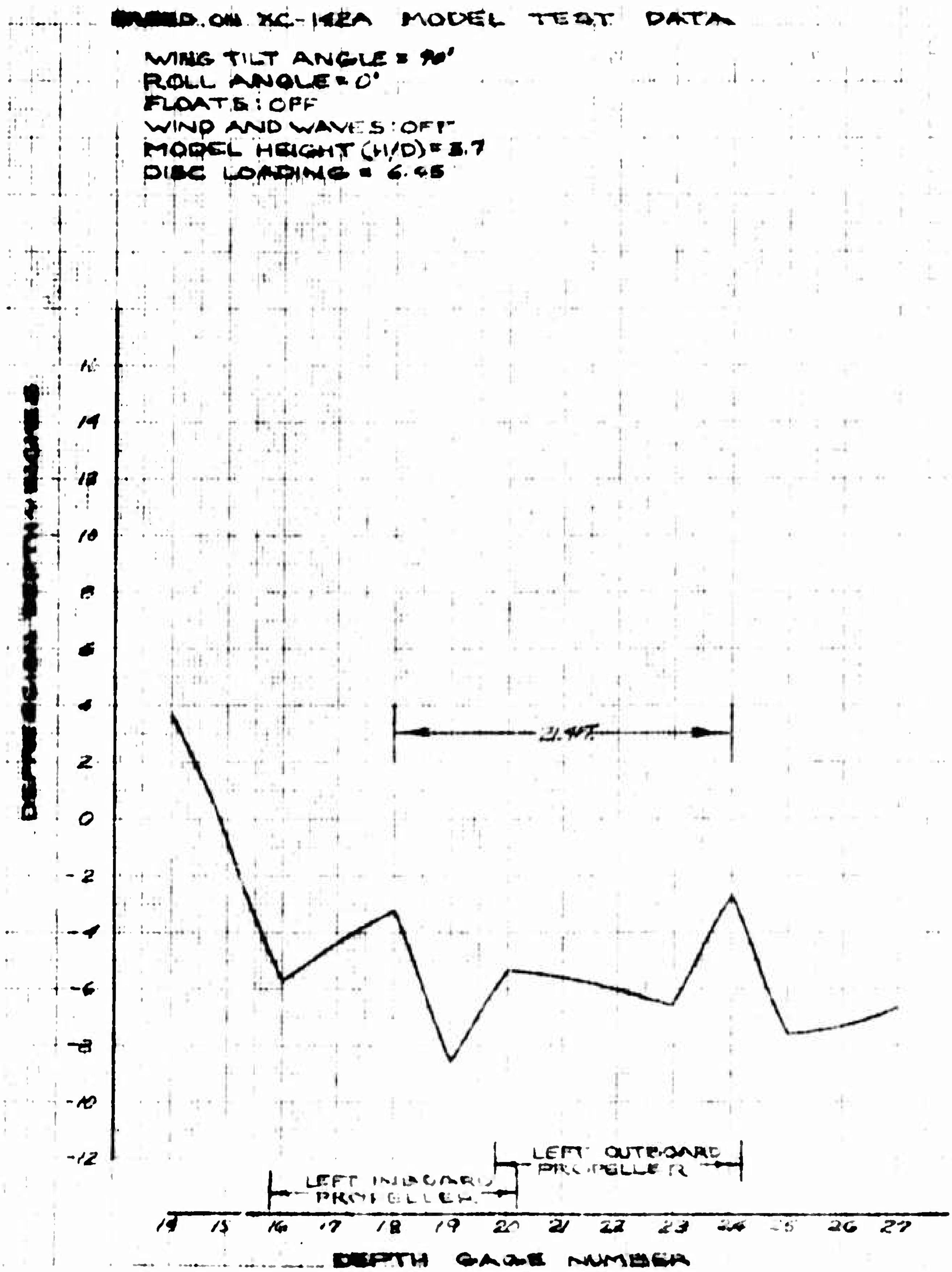


Figure 4-84 Water Displacement Along Propeller Centerline - Predicted Full-Scale XC-142A Depression

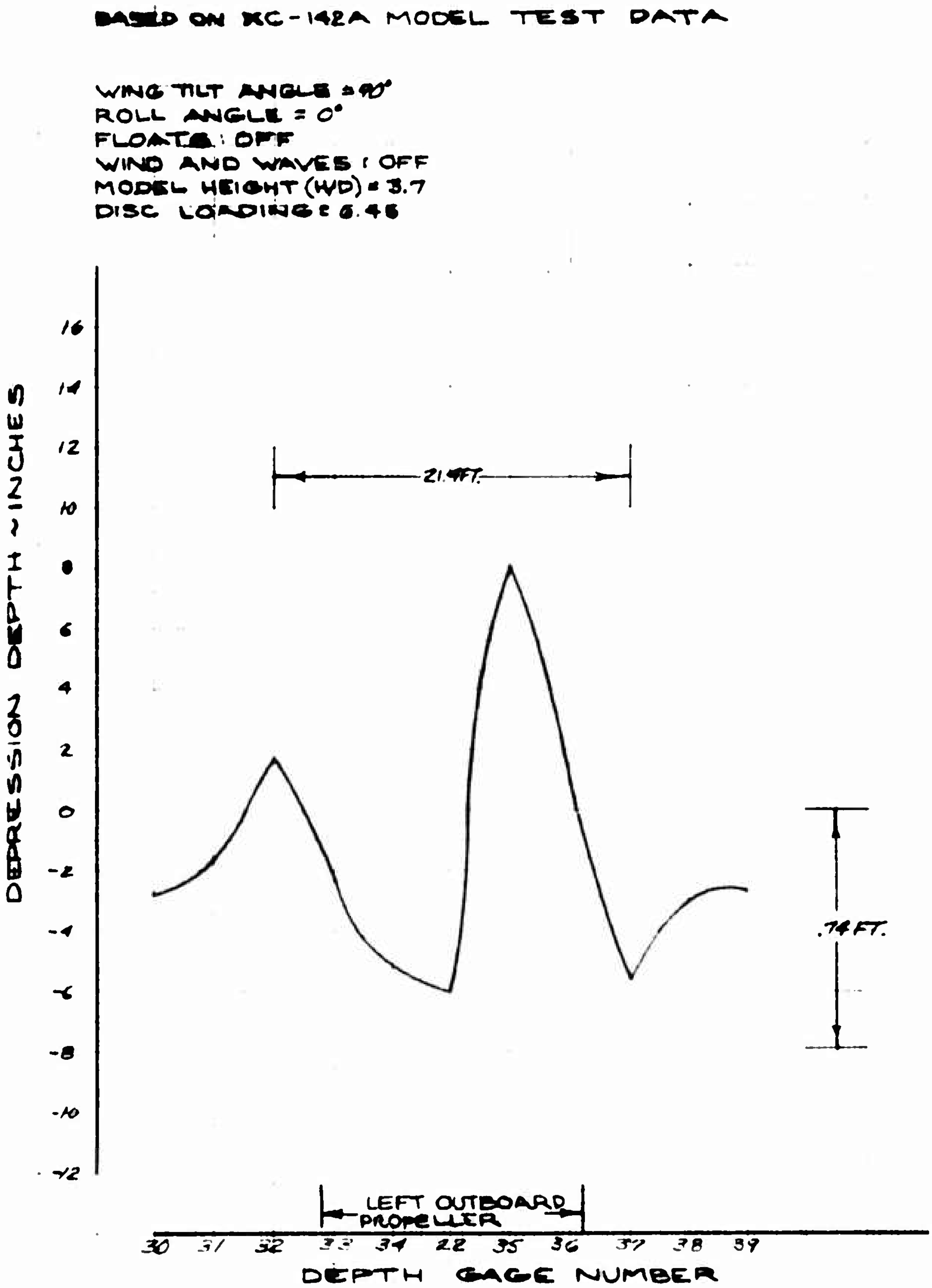


Figure 4-85 Water Displacement Along Propeller Centerline - Predicted Full-Scale XC-142A Depression

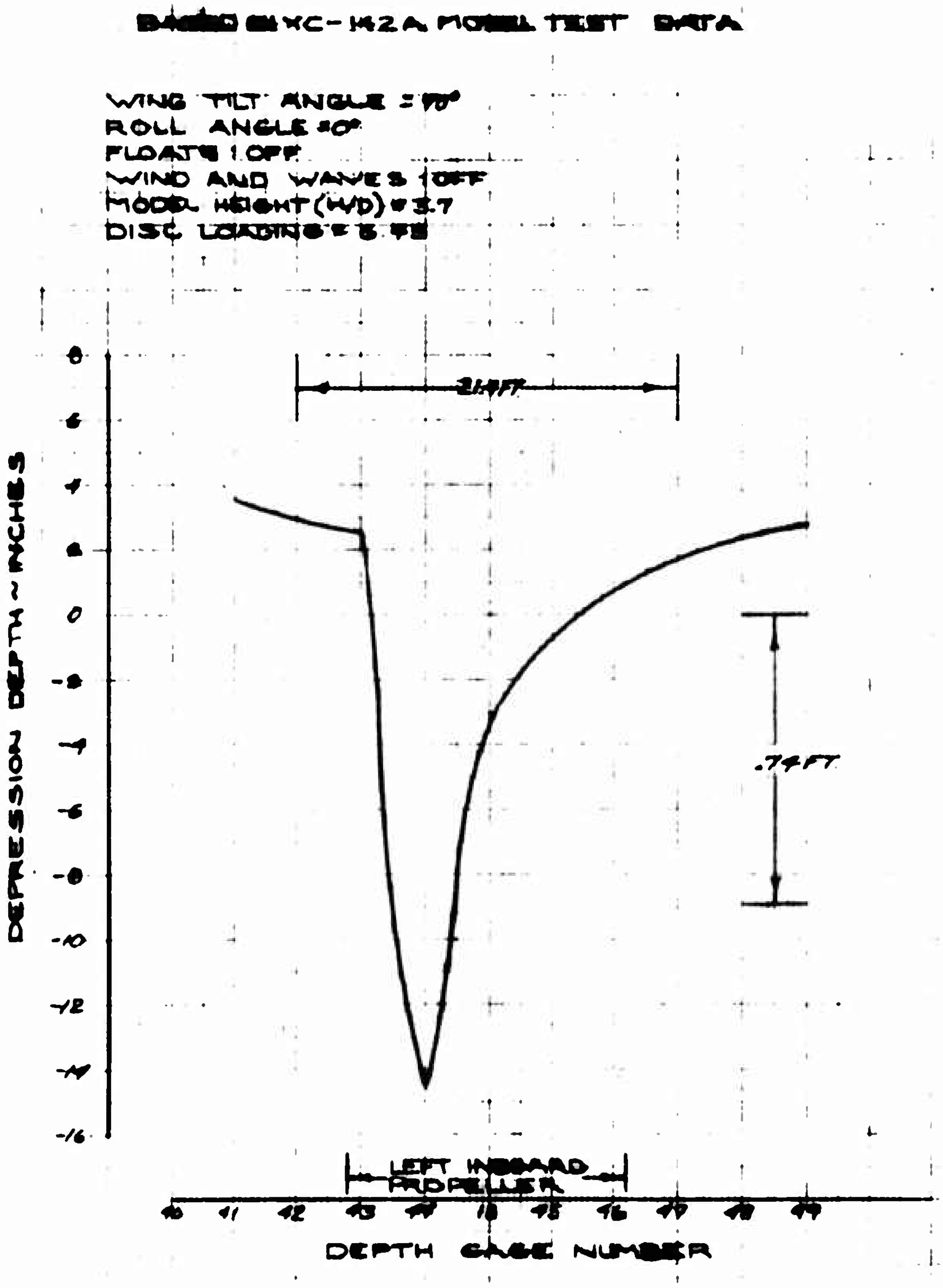


Figure 4-86 Water Displacement Along Propeller Centerline - Predicted Full-Scale XC-142A Depression

5.0 CONCLUSIONS

A series of tests have been performed with a model having a tiltwing configuration and four propellers simulating a hover over a calm water surface with and without a surface wind, and over a water surface having two wave heights both with and without a surface wind. These tests examined the forces and moments acting on the model and the environmental conditions generated by this model. As a result of these tests, the following conclusions are drawn:

a. The forces and moments acting on the model were not affected by the waves on the water surface below the model.

b. The addition of vertical floats to the model had a negligible effect on the forces and moments felt by the model in the hover mode.

c. Rolling the model as much as 10 degrees had a negligible effect on the normal, drag and side forces and the pitching and directional moments.

d. The addition of a surface wind had a negligible effect on the normal force, but the effects of the surface wind on the pitching moment were large. The pitching moment coefficient, based on the slipstream dynamic pressure, increases by a value of approximately 0.4 for the full-scale disc loading of 42.5 pounds per square foot; at a higher disc loading (125 pounds per square foot), the moment coefficient increase due to the surface wind was only 0.25.

e. Wind had the largest effect on spray circulation, forcing the spray on the windward side up and back over the model.

f. Small waves can be destroyed by the slipstream and, in this case, more spray is generated than with larger waves which are not destroyed.

g. The increases in spray circulation caused by wind and waves independently are approximately additive when encountered simultaneously.

h. The correlation parameters presented in Reference 4-9 can be used to predict depression characteristics although better depth predictions can be made using Figure 4-84.

i. The method outlined in Reference 4-7 is adequate for predicting maximum droplet size.

j. The addition of vertical floats reduces the amount of spray circulation by spray deflection.

k. The addition of polyethylene oxide to the water beneath the model showed some promise as a spray inhibitor by increasing the spray droplet size, and such an additive may prove useful for full-scale aircraft.

l. Based on model data, it is estimated that a full-scale tiltwing airplane with engines that require approximately 25 pounds of air per second and having a 50 psf disc loading would probably not ingest more than 2 ppm salt-in-air hovering near the water under zero sea state conditions, and not more than 100 ppm in a sea state 4.

m. The majority of the spray droplets in the model flow field were less than 100 microns in diameter.

n. Electrical depth gages can be used to determine the frequency of water motion in still water and to determine the wave/slipstream interactions.

o. These tests have shown the developed test facility to be excellent for evaluating the characteristics of spray around a V/STOL aircraft hovering above a water surface. Good correlation has been found between the spray patterns formed beneath a full-scale airplane and tests at this facility of a model under comparable test conditions.

p. During these tests it has been found that a coating of neoprene that is approximately 0.01 inches thick applied to the blades of the fiberglass propellers virtually eliminated the spray-caused erosion of these blades.

q. There are certain disc loadings above which it will be impractical to operate V/STOL aircraft near a water surface. This maximum tolerable disc loading will reduce as the size of the waves and/or the magnitude of the surface wind increases.

6.0 RECOMMENDATIONS

As a result of these tests, the following recommendations are made:

a. A series of tests should be performed using models of other types of V/STOL aircraft in this test facility in order to properly evaluate their compatibility with an open ocean type of environment.

b. Areas such as the visibility available to the pilot of a V/STOL aircraft hovering over a water surface should be quantitatively measured.

c. Additional tests of compounds similar to polyethylene oxide should be performed in an attempt to find an effective and practical spray suppressant.

7.0 REFERENCES

1-1 "An Investigation of the Over Water Aspects of VTOL Airplanes at High Disc Loading," Final Report No. 012-26, Curtiss Wright Corp., December 1963.

1-2 "Feasibility Study, XC-142A Modified for Open Ocean Operation," Report No. 2-55400/4R-963, Vought Aeronautics Division, 9 February 1965.

1-3 "Research on VTOL Water Hover Effects," Report No. 2-55400/6R-6090, Vought Aeronautics Division, 30 September 1966.

1-4 Office of Naval Research Contract No. N00014-67-C-0488, dated 5 May 1967.

4-1 "Engine/Airframe Interface Study for Open-Ocean ASW Air/Sea Craft," Report No. 2-55400/7R-2419, Vought Aeronautics Division, 30 June 1967.

4-2 "Research on VTOL Water Hover Effects," Report No. 2-55400/6R-6090, Vought Aeronautics Division, 30 September 1966.

4-3 "An Investigation to Determine Conditions Under Which Downwash from VTOL Aircraft Will Start Surface Erosion from Various Types of Terrain," NASA TND-56, September 1959.

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4-5 "Downwash Impingement Design Criteria for VTOL Aircraft," TRECOM Technical Report 64-48, U. S. Army Transportation Research Command, August 1961.

4-6 "Feasibility Study, XC-142A Modified for Open Ocean Operation," Report No. 2-55400/4R-963, Vought Aeronautics Division, 9 February 1965.

4-7 "Shock Tube Investigation of the Breakup of Drops by Air Blast," The Physics of Fluids, Vol. 6, August 1963.

4-8 "Experimental Study of Pilot Visibility From a VTOL Air/Sea Craft Near the Ocean Surface," TAR-TR 6704, Therm Advanced Research, Inc., July 1967.

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13. ABSTRACT

Very little is known about the problems associated with a VTOL aircraft hovering over a water surface. Some of the more important of these unknown effects appear to be the effects of surface winds and waves on the stability and control characteristics of the hovering airplane, the effects of the airplane's downwash on the water surface, and the effects of surface winds and waves on the spray generated by the airplane's downwash. In order to examine these seemingly more important effects, a special model testing facility has been built. This facility permits a model simulating a hovering airplane to be tested as the facility generates waves of variable heights and lengths on the water surface below the model test station. The facility can also generate a surface wind. During this test a model of a tiltwing VTOL airplane with four propellers was tested as it simulated hover at varying heights and disk loadings above the variable water surface conditions. The effects of water waves on the forces and moments felt by the hovering model were found to be negligible, and the effects of the surface wind on the forces and moments were found to be as would be predicted with a negligible effect of waves even with the surface wind. By contrast, it was found that the waves and the surface wind both had significant effects on the effects of the airplane's downwash on the water surface and the spray generated around the model. Comparison of some of the spray patterns found in this test program with results of full scale airplane tests indicate that these results of the model tests correlate well with the limited data available from the actual airplane tests.

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UNCLASSIFIED
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Air/Sea Craft						
Open Ocean Operations						
Roll attitude						
Hover						
VTOL						
Tiltwing						
Surface winds						
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Forces						
Moments						
Downwash						
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Edge effects						
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Height above water						

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